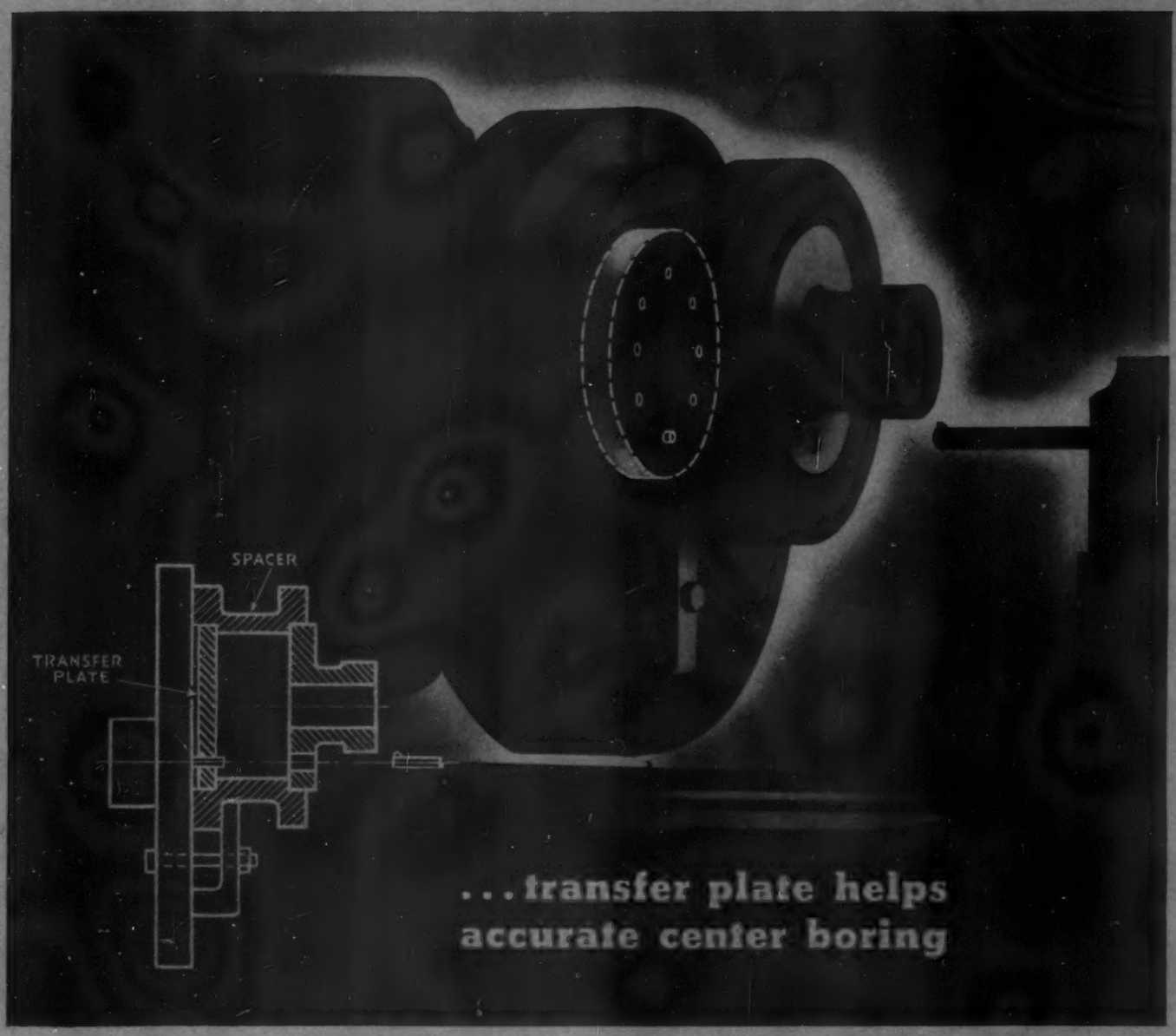
TECH ENGINEERING NEWS
MASSACHUSETTS INSTITUTE OF TECHNOLOGY

TOMORROW'S IRON HORSE

SEE PAGE 132



. . . transfer plate helps accurate center boring

Information supplied by an Industrial Publication

The problem of drilling a number of holes in a part on precise center distances is seldom simple. It is particularly complicated in mass production of parts where holes must register accurately.

The answer in one plant is what is known as a transfer plate. This is really a circular template, of any thickness over ⅛ inch, with uniform holes drilled on accurate centers. These holes fit a pin located at the exact center of a lathe face plate.

In mounting, the work is assembled to the transfer plate with a spacer between. The assembly is pinned to the face plate through one of the holes in the transfer plate, and clamped tight.

A boring bar in the lathe tool rest can be used to bore a hole of any desired size in the work. The hole will be exactly in line with the pin, and consequently with the hole in the transfer plate.

Subsequent holes are bored by passing the pin through the remaining holes in the plate, until all are bored. When finished, every hole, regardless of diameter should be on the same center as the corresponding hole in the plate.

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MOLY

"PERISCOPE ON THE STARBOARD QUARTER!"

IN SUBMARINE-infested waters, a speeding destroyer must be able to change its course in a split-second—to drop its deadly ashcans on enemy U-boats.

The secret of the destroyer's great *speed* and *maneuverability* is the tremendous power of its turbines, operating at steam temperatures *high enough to make the turbine blades glow!*

This introduces a difficult problem in turbine construction. The highly heated metal parts "creep" under stress. The metallic grains slowly slide over each other. The metal tends to *flow* out of shape.

Excessive "creep" would quickly destroy the turbine — due to collision between the blades and other parts of the turbine, which are spaced only a *fraction of an inch apart* for maximum power.

Westinghouse first introduced the steam turbine in the United States and has built thousands during the past 45 years.

And much of the success of Westinghouse steam turbines is due to the intensive studies of "creep"—similar to those conducted by Dr. A. Nadai, P. G. McVetty, and M. J. Manjoine, in the Westinghouse Research Laboratories.

As a result of this research, the "creep" in some turbine metals has been reduced to 1/10,000th of an inch per inch per year—less than 1/64th inch per inch in 100 years.

This has guided the development of metals capable of operating at greatly increased temperatures and speeds—and secured *more power per pound of turbine*, a vital necessity in a destroyer!

* * *

Research Engineer Manjoine, in collaboration with Dr. Nadai, is fighting a deadly battle against the submarine menace — by improving metals that make possible *faster, more maneuverable* ships for our Navy.

Manjoine is typical of the many young engineering graduates who are putting Westinghouse skill and "know how" to work for victory—and for a better kind of civilization when peace returns.

Westinghouse Electric & Manufacturing Company, Pittsburgh, Pennsylvania.

Slower "creep" means faster ships — Research Engineer Manjoine studies "creep" of test samples to develop turbine metals that will deliver more horsepower per pound—making our destroyers speedier and deadlier. Manjoine received his B. S. from Iowa State College, before joining Westinghouse in 1937.

Westinghouse

PLANTS IN 25 CITIES OFFICES EVERYWHERE

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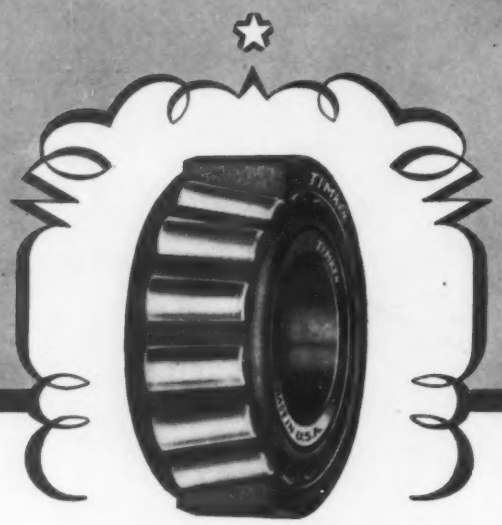

The war production program is a good example of the value of "knowing your bearings". For many years before the war, engineers were putting Timken Tapered Roller Bearings into industrial machinery of all kinds. They discovered long ago that these bearings possessed every quality needed to meet any type of service—friction elimination; radial, thrust and combined load capacity; and the ability to hold moving parts in correct and constant alignment.

Thus, when America was faced with the most tremendous production job ever known, industry had one big advantage —namely, production machines with the speed, precision and endurance to do it; machines that could out-produce any others in the world.

Now the results are beginning to tell on the world's battle fronts—where Timken Bearing Equipped fighting machines turned out by Timken Bearing Equipped production machines are steadily turning the tide of war in our favor.

When Victory has been won and industry calls you to help in the work of reconstruction, you'll find a thorough knowledge of Timken Bearings one of your most valuable assets. Begin to get it now.

THE TIMKEN ROLLER BEARING COMPANY, CANTON, OHIO

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TRADE-MARK REG. U. S. PAT. OFF.
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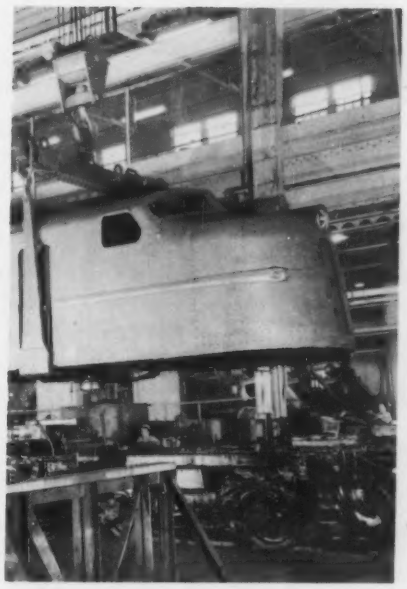
THE TECH ENGINEERING NEWS

MAY · 1943



COVER

Six twin motors representing 4800 horse power will make it possible for this locomotive to pull a 5000-ton train at a speed of 65 miles per hour. ***(See page 132.)***

Westinghouse Electric and Manufacturing Company

VOLUME XXIV

NUMBER 6

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REHOUSING *VS.* REHABITATION

URBAN RECONSTRUCTION PRESENTS A POST-WAR CHALLENGE

By PROFESSOR FREDERICK J. ADAMS

EVERYONE who has taken the time to investigate conditions in our cities recognizes the need for large-scale replanning and reconstruction. Both the basic pattern and a large proportion of the structures in our cities are physically and economically obsolete, with the result that our urban communities fail to provide their inhabitants with more than a modicum of decent conditions for living and working. Before we start any large-scale program of rebuilding, however, we must have a pretty clear idea of the scope of the problem and of the primary objectives of our program. In other words, we must decide what things need to be done and which ones should be done first.

Various proposals for a post-war program of urban reconstruction have been put forward by public and private agencies, and it is probable that some scheme involving the participation of Federal and local authorities in coöperation with private interests will be adopted as a re-employment measure when men and materials are again available. For this reason it would seem important that local authorities have a clear understanding of the social and economic implications of alternative proposals for the redevelopment of urban areas, as otherwise they may find themselves in the position of having to collaborate on a post-war construction program regardless of its desirability from the standpoint of long-range planning.

The magnitude of the problem we face can be realized by analyzing the costs involved in a comprehensive reconstruction of our blighted urban residential areas. These, of course, would form only part of any urban redevelopment program, as our commercial, industrial, and transportation centers are in many cases equally obsolete, and their efficient functioning is essential to a sound municipal economy. There should be no argument, however, as to the importance of the home neighborhood to the economic and social life of the people, and if our post-war program of redevelopment does not include a pretty drastic reshaping of many of our urban residential areas, we might as well contribute our cities to the junk pile or, at least, to the national salvage drive.

Who Should Do the Job?

If we recognize that the fundamental weakness of our cities as places for living and working lies in their obsolete *physical pattern*, then we will not rely on a large-scale public *housing* program alone to do the job of rebuilding our residential areas. A neighborhood is much more than just the dwelling units in which the inhabitants spend a portion of their time. Streets, recreational facilities, open spaces, shopping districts, and other essential features of a community are at least equal in importance to the structures in which the people dwell as parts of the environment. It is not overlooking the basic deficiencies of existing housing accommodations to meet modern needs when we say that the obsolete physical design of our cities is the major cause of the flight to the suburbs. As has been stated by the Land Committee of the National Resources Planning Board, "The basic maladjustment behind most urban land problems today lies in the irrationality of urban patterns."

While public housing projects cannot be depended upon to change the face of our cities to a radical degree in the next generation, neither can we assume that private enterprise is equipped to do the job unaided — however much freedom of operation is accorded it. This is not any criticism of the social-mindedness of private enterprise (although such criticism is in many cases justified) but is due to the inescapable fact that a large proportion of our urban population earns an

Frederick J. Adams, Associate Professor of City Planning at the Massachusetts Institute of Technology, has for the past ten years been in charge of the Institute's professional course in City and Regional Planning. He has served as consultant on planning and zoning to a number of communities in Massachusetts and at the present time is associated with Professor Flavel Shurtleff in the preparation of a revised zoning ordinance and master plan for Hartford, Conn. Professor Adams studied civil engineering and architecture at McGill University, Montreal, and at the Architectural Association School, London, and received the degree of Bachelor of Architecture from Columbia University in 1929. He is a member of the American Institute of Planners and the American Society of Planning Officials, and served from 1937 to 1941 as editor of *The Planners Journal*. He is a member of the American Public Health Association's Committee on the Hygiene of Housing and is chairman of its subcommittee on Environmental Standards for Residential Areas.

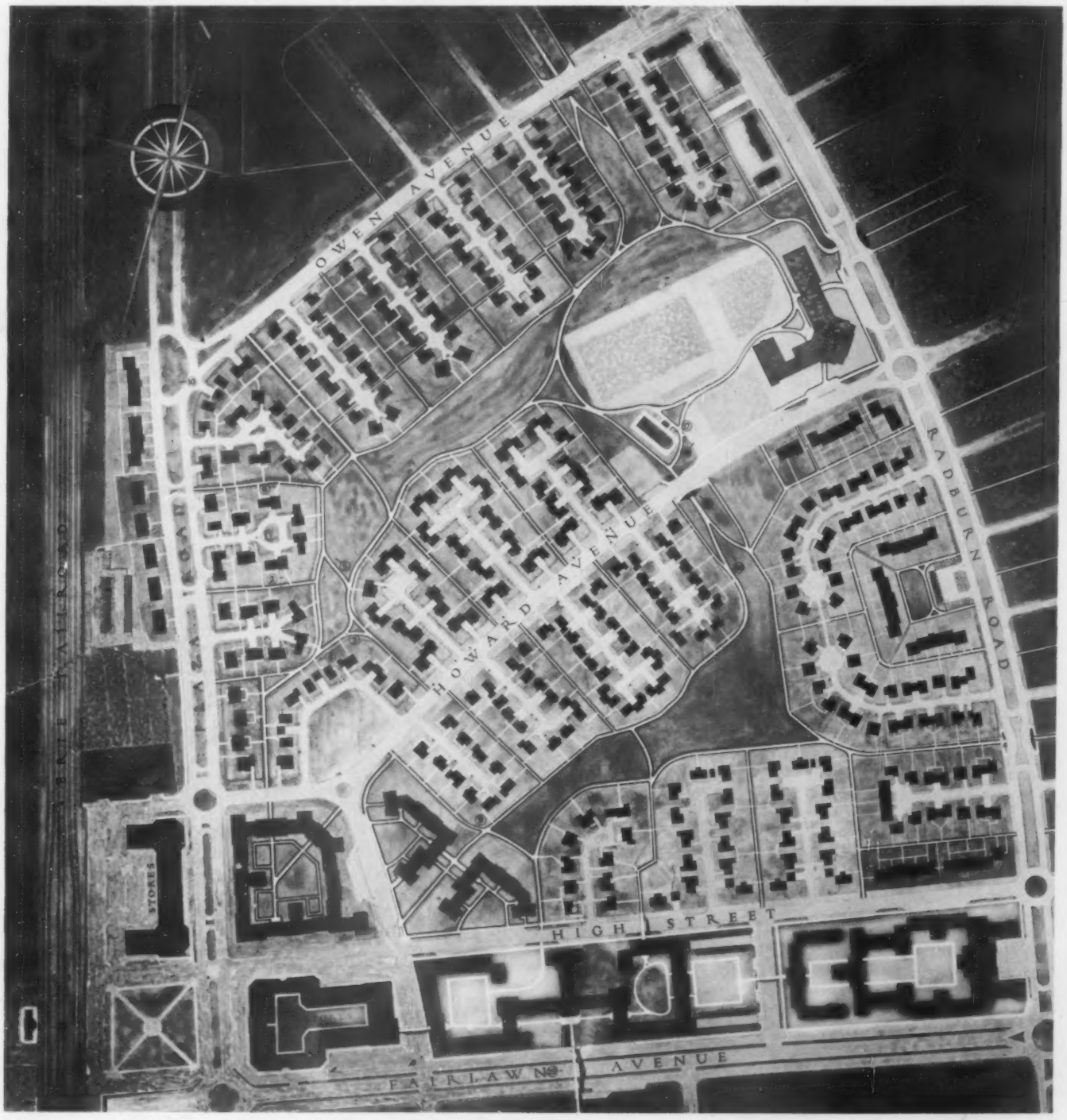
Boston's South End, where lives six per cent of the city's 770,000 people. Comprising an area of about 435 acres, it has less than seven acres devoted to active recreational uses — or the equivalent of a lot only 60 feet wide and 100 feet deep for each 1000 inhabitants of the district. The Boston City Planning Board estimates that this is less than one-fourteenth the amount which should be available for such a purpose. The assessed valuation of land and buildings averages about $3 per square foot, or $130,000 per acre. *Boston Housing Authority*

The cross-hatched area shows the site of the Boston Housing Authority's Cathedral Project, which will house 446 families on 6.18 acres and is expected to cost $2,800,000 including the land. The cost of rehabilitating the whole South End, including the provision of an additional 60 acres of parks and playgrounds and the construction of a $400,000 neighborhood recreation and swimming-pool building, but not including the cost of rehousing the families displaced by the clearance program, is estimated by the M. I. T. Redevelopment Field Station at approximately $6,500,000.

income which makes the payment of an economic rent for new residential structures an impossibility. Improved methods of construction and higher average incomes will of course help the situation, but to assume the validity of any proposed program of urban rehabilitation for application on a large scale which attempts to operate on a basis of private profit alone is to blind ourselves to the realities of the problem. Therefore, if this solution is inadequate and if the job of housing in new dwelling units from five to ten million families now living in substandard structures is too big a job to be handled on the basis of a hundred per cent subsidy by Federal, state, and local governments, then we must develop a post-war program which would be essentially a joint venture by government and private enterprise.

In the hope of obtaining at least a partial answer to some of the above problems, a research program is now under way in the Urban Redevelopment Field Station, set up last year by M. I. T.'s City Planning Division with funds granted for the purpose by the Albert Farwell Bemis Foundation. With the aid of two consultants (Edwin H. Spengler, Associate Professor of Economics at Brooklyn College, and Philip H. Cornick, of the Institute of Public Administration, New York City), the research staff has completed a detailed cost and income analysis of an area containing nearly two hundred acres and inhabited by six thousand families in Boston's South End. Estimates have been prepared of present municipal costs of operating this area and of changes in these costs which might be expected if the neighborhood were rehabilitated, together with anticipated changes in the annual revenue received in taxes

Radburn, N. J. "The Town for the Motor Age." An example of the superblock system of neighborhood design applied to the planning of an extensive residential area. *Clarence S. Stein and Henry Wright, Architects*



***Harlem River Houses.** An island of good housing in a sea of blight. Over half a million families still live in "old law" tenements in New York City, and another million live in "new law" tenements, which replaced the former after the passage of the Tenement House Act of 1901. However, only a little over one per cent of the "new law" tenements built on Manhattan Island during the five years prior to 1933 rent for less than $12.50 per room per month.* U. S. Public Works Administration

on property. The results are illuminating, and it is hoped that the study will shortly be available in published form. Only a brief outline of its implications can be attempted here.

The Costs of Urban Redevelopment

(A) In considering the costs of the rehabilitation of residential areas we have three major elements to consider:

1. Construction costs of redevelopment, including the provision of new community facilities and services.
2. Land acquisition costs for neighborhood replanning, including (where necessary) additional areas for public recreation.
3. Land and building costs for rehousing of families now living in obsolete residential structures, whether undertaken by public housing agencies or by private building corporations.

The costs of the above items will vary, of course, in different parts of the country and in different cities in the same region. Land acquisition costs, for instance, which are often the biggest item in neighborhood replanning, may vary tremendously from one section of a city to another. However, it is possible to approximate these costs on the basis of a number of studies which have been made and to put them on a per capita or per family basis.

In a typical blighted residential area an expenditure of approximately $175 per family would appear to be necessary to provide for the construction of needed facilities and services. Land acquisition costs in such areas vary from $1 per square foot in some cities to anywhere from $5 to $20 on Manhattan Island. The average for the City of Boston is about $2, using 1940 assessed valuations. However, a figure of $1.50 per square foot would perhaps be a reasonable average for all the large cities in the country, assuming that compensation would have to be paid for the obsolete buildings occupying the land as well as for the land itself.

How much land per family would have to be transferred from private use to public use if these areas were redesigned to provide sufficient open space for normal healthy living? This figure would be in the neighborhood of 150 square feet per family, assuming that about half the required open space was already available either in existing parks and playgrounds or in excess street area which could be recaptured for recreational use. At $1.50 per square foot the land acquisition cost for community facilities would therefore average approximately $225 per family which, added to the figure of $175 for physical improvements, would give a total of $400 per family for land acquisition and construction.

(B) The rehousing of families now living in obsolete

(*Continued on page 144*)

***Radburn, N. J.** The first portion of the town to be developed, as seen from the air. Notice segregation of pedestrian circulation from automobile traffic.* Clarence S. Stein and Henry Wright, Architects

THE QUEST FOR POWER

THE NEED FOR MORE POWER IN OUR RAILROAD SYSTEMS MAY LEAD TO STARTLING CHANGES IN LOCOMOTIVE DESIGN

By CHARLES KERR, JR., '22

RECENT years have witnessed a very extensive development in locomotives of all types — electric, steam and diesel-electric. While these developments have captured the imagination of the traveling public, we can confidently look forward to further progress in the future.

In general, the railroads of this country are operated by three types of locomotives — steam, diesel-electric and electric. For years we have heard the merits of each type sung by its proponents, and have likewise heard that each type would some day supplant all others. Under present railroad operation and economic conditions, there seems to be no doubt that each type has its place and that each type will continue to serve for many years to come.

Steam Locomotive

For many reasons the rank and file of railroad operations are performed by the steam locomotive. In the first place the steam locomotive costs less than any other type, and in a large majority of railroad jobs, locomotives do not operate sufficient miles annually to warrant the higher first costs of other types. Secondly, the steam locomotive is getting better every day.

Conventional reciprocating locomotives are being built to develop approximately the following horse power at the rail:

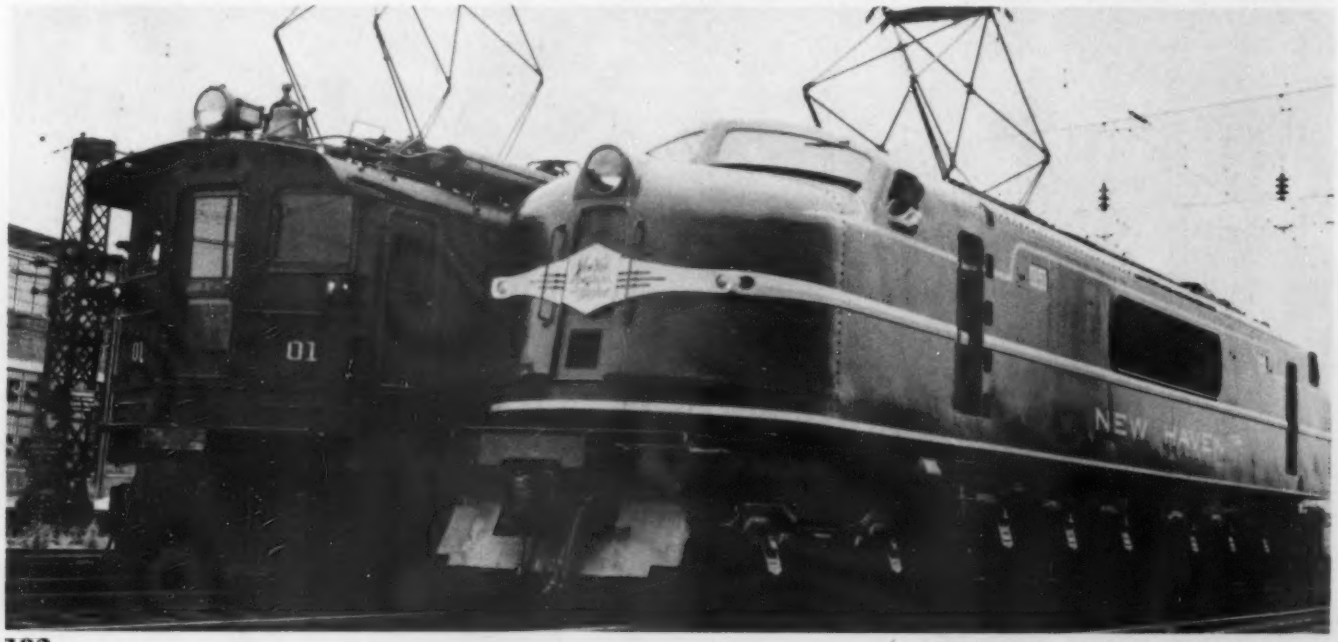
Charles Kerr, Jr., transportation engineer of the Westinghouse Electric and Manufacturing Company, is a native of Lexington, Ky. He received the degree of B.S. from the University of Virginia in 1919 and another in Electrical Engineering from the Massachusetts Institute of Technology in 1922. Mr. Kerr was active in engineering development associated with the Pennsylvania Railroad electrification between New York and Washington and motive power developments on other railroads.

three driving axles	3800 horse power
four driving axles	4500 horse power
five driving axles	5500 horse power
six to eight driving axles	6000 horse power

Further developments are taking place such as the 40-cylinder non-articulated type for high speed passenger service.

It is realized by many operators that future competition may force the railroads to handle heavy trains at speeds far above any now common. When speeds increase, the horse power required of the locomotive goes up very rapidly. For example, it requires 5000 horse power to move a 5000-ton train at 50 miles per hour, but 10,500 horse power to move the same train at 70 miles per hour. Any radical increase in the horse power of the reciprocating steam locomotive does not

To contrast thirty-five years of progress in locomotive design, the 01, the original 1012 horse power locomotive for New Haven Electrification, is shown with one of the new 4860 horse power locomotives. *Westinghouse Electric and Manufacturing Company*



seem probable. The boiler size and axle weights are now at the permissible limits. Hence, the only avenue now apparent for improvement is through refinements in design, not through basic changes.

Steam-Turbine Locomotive

However, the direct-drive steam-turbine locomotive gives promise of retaining all of the basic features of steam generation, but effecting a more efficient use of this source of power. Modern developments in the marine drive have succeeded in producing turbines and gearing capable of operating at very high speeds and of a type which offers definite prospects for application to locomotives. At the speeds marine turbines are now operating, they can be built to weigh about one pound per horse power — or a weight comparable to that of an aeroplane engine. Including the gearing, flexible connections to the axle and other auxiliary apparatus, the entire assembly can probably be built at about five to seven pounds per horse power. Such weights are far less per unit of capacity than can be obtained by other classes of equipment. When applied to modern locomotive boilers of around 300 pounds pressure and with super heated steam well within the limits of existing superheater design, the turbine offers a decided advantage by permitting greater output per pound of steam developed. This permits a higher horse power from the same boiler and carries with it the attendant advantage of fuel economy. Studies indicate that a turbine drive, which eliminates reciprocating parts, can be applied with considerable advantage to any type of wheel arrangement and any size of boiler now developed for steam service. When so applied, the turbine will likely offer an increase in high-speed output per pound of steam and per pound of locomotive of about 25 per cent over reciprocating engines. Its cost per horse power in the larger sizes should not be far different from that of reciprocating engines.

Diesel-Electric Locomotive

The newcomer, so to speak, to the railroads is the diesel-electric. From its first application to railroad service about 1925 to the present day, it has continually increased in popularity until today there is some 2,000,000 horse power in service or on order. Its application has been to switching, main-line passenger, and main-line freight services.

In switching service, the most popular sizes are the 660-horse power, 100-ton locomotives and the 1000-horse power, 125-ton locomotives. Smaller sizes have become popular recently for the smaller railroad yards and industrial switching services. This type of equipment has been standardized to a considerable extent and has definitely proved its economy in rail service. In 1941, the diesel-electric locomotive performed 12 per cent of the total switching service on Class 1 railroads.

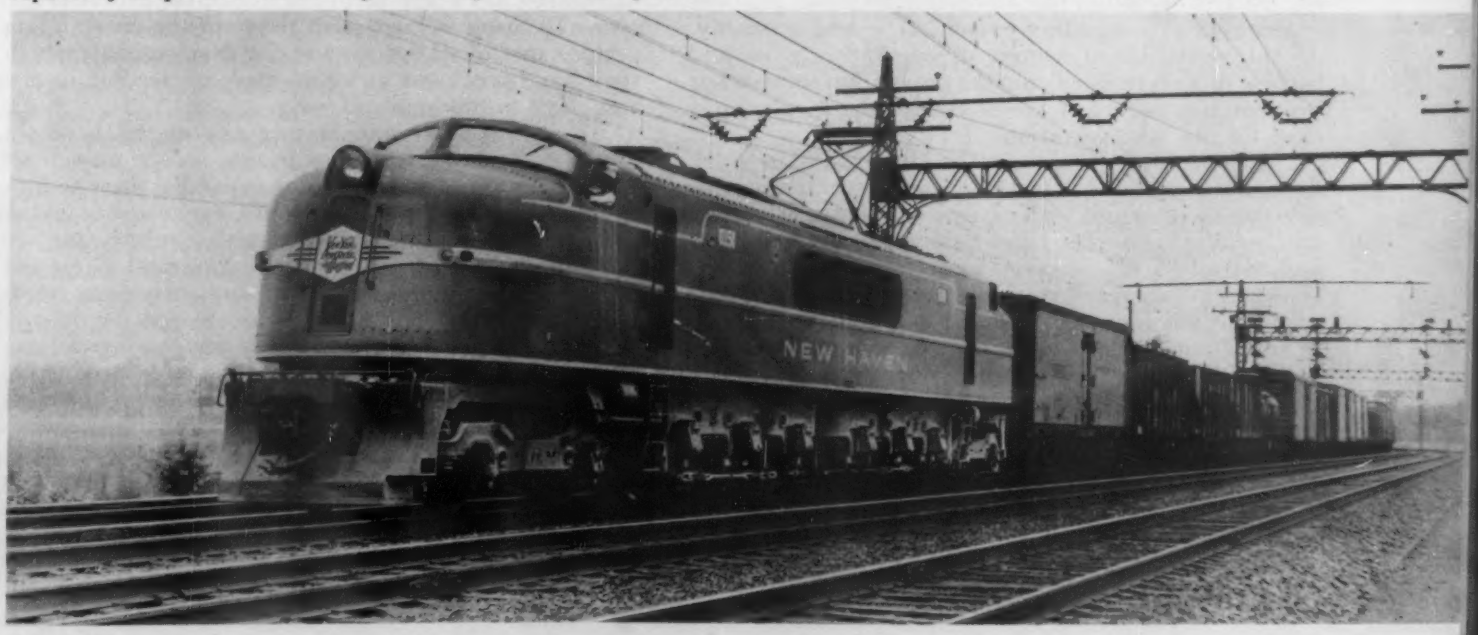
In high-speed passenger service, the diesel-electric has continued to go forward. Its early application was on rail cars in very small sizes. Today, passenger locomotive units of 2000 horse power each are used, these same units being coupled in multiple to give 4000 to 6000 horse power locomotives where the conditions demand. In 1941, diesel locomotives in passenger service operated about 30,000,000 miles, or seven per cent of the main-line passenger service of this country. This percentage is small, but the rate of increase is large.

In freight service, two-cab locomotives of 2700 horse power and of 4000 horse power and four-cab locomotives of 5400 horse power are available. Up to January 1, 1942, a total of 237,000 horse power had been purchased for freight service.

It is difficult as yet, in many ways, to truly evaluate the diesel locomotive and its ultimate place in the railroad field. Some of its more ardent proponents claim that it will be the cure-all for the railroads. In the early stages of electrification, some enthusiasts made similar claims for the electric locomotive. Unquestionably, the diesel locomotive will have a definite place, but it is most unlikely that it will exclude all other types of locomotives.

The future development of the diesel locomotive is dependent largely upon the engine itself rather than the electric drive. In a 2000 horse power locomotive of 1940, about 44 per cent of the total weight is engine and drive, or about 60 pounds per horse power. The extent to which larger units can be constructed depends

One of the new Baldwin-Westinghouse 11,000 volt, 250 ton, a-c freight locomotives in service on the New Haven Railroad. A novel feature in the design of these locomotives is that they can be converted readily into high speed passenger service whenever the need arises. Their nominal continuous rating is 4860 horse power, at 65 miles per hour, but are capable of outputs at the driving wheels up to 900 horse power. *Westinghouse Electric and Manufacturing Company*



upon the ability to increase the speed of the power plant so that more capacity can be placed within the same space and for the same weight. As the transportation industry has always been progressive in the concentration of capacity, the same development is taking place in the diesel-electric field. New developments give every promise of 6000 horse power diesel-electric locomotives in one cab in the very near future. This locomotive, incidentally, will also include electric braking.

Thus over a relatively short period of time, the diesel engine has grown from a motive-power unit suitable only for rail-car operation to a unit for locomotive service in heavy-duty work. As the art of effectively using materials at high speed progresses, even further progress in the diesel-electric locomotive will take place.

Electrification

As a means of economically providing mass transportation at high speeds, no form of motive power can equal electrification. From the initial installation of electric operation in this country in 1895, and including the early operations of electric locomotives on the Baltimore and Ohio, New York Central, New Haven, and Pennsylvania Railroad about the turn of the century, electrification has grown both in this country and abroad. It has reached its highest development to date in the Pennsylvania Railroad's installation connecting New York, Washington, and Harrisburg. Electrification is not the cure for all railroad problems, but as we see the place of electrification in the future, it will economically serve essentially two classes of service better than any other kind of power:

First: Heavy suburban service in the larger centers of population.

Second: Heavy traffic main lines which are so situated that they must be served by the best obtainable form of rail transportation.

The rapid expansion of the power facilities of the country and the general tendency towards lower price for electrical energy should promote the use of electric traction to a considerable extent. Electricity is the only kind of power or fuel whose price trend is downward.

In 1941 over 50 per cent of the suburban traffic operated by Class 1 railroads was powered by electric motive power, principally by what we term multiple unit cars. For this type of heavy-duty suburban service, electric operation has absolutely no equal in speed — removal of congestion — comfort — and economy. As the metropolitan centers of population grow and become more congested, and the population spreads out towards the suburban areas, there should develop a need for rail transportation.

Modern developments in the city transit industry have shown that a very fast ride and a very comfortable ride can be produced with extremely rapid accelerating and braking rates when these rates are properly applied and controlled. These same developments have further shown that wherever this improved service has been offered, it has been accompanied by a marked increase in traffic and has proved to be profitable.

Developments which are now under way give promise of producing the same kind of improvements in equipment for main-line suburban service. It seems possible to produce a main-line car capable of attaining a speed of 75 miles per hour in less than 60 seconds, with smooth acceleration throughout — and to produce this car so that it can be operated for a reasonable expense. The average main-line suburban operation involves service where the average distance between stations is approximately one and one-half miles. The new type of car I have mentioned, operating with a maximum speed of 75 miles per hour, can maintain a schedule speed of 40 miles per hour in this frequent-stop service, because of its ability to get under way rapidly and its ability to stop as quickly. No other form of transportation, not even the private automobile, can approach this 40-miles per hour schedule for the delivery of passengers.

The most comprehensive electrification now in operation in this country is that of the Pennsylvania Railroad, where heavy main line passenger, freight, and suburban operations are included. This electrification has not only met, but exceeded, every expectation in every way. By this electrification of the main arteries of commerce of the congested Eastern seaboard, the Pennsylvania Railroad has provided this area with a standard of operation which would have been unattainable economically with diesel or steam motive power. In this operation, fleets of passenger trains, ranging as high as 18 to 20 cars, are operated on unequalled schedules, employing locomotives capable of developing, when needed, outputs of 8000 to 9000 horse power. Similarly, freight trains up to 12,000 adjusted tons are operated on schedules previously considered excellent for locomotive wheels of 13,000 horse power.

With the realization that larger locomotives will soon be required for heavy traffic lines which can be best served by electrification, apparatus for locomotives capable of maximum outputs of 12,000 horse power is being developed. Designs may be no larger physically than those of present locomotives.

The output of electric locomotives can be made roughly twice that of either the diesel or the steam locomotive. This is made possible by the fact that electric locomotives draw their power from an overhead trolley which is backed up by a huge power system. Therefore, wherever the traffic is such as to warrant the utmost in rail performance, the electric locomotive can outperform any other type.

I have covered briefly the present status of motive-power development in this country and also given some indications of what the future may hold. The railroads of the country are primarily responsible and deserve the credit for this development, for they have been progressive always and have encouraged the manufacturers to do what they have done. Because of this foresight in providing for the United States a rail service unequalled anywhere in all the world, the railroads are prepared to serve the nation today in the outstanding performance of all time — and the developments which they have promoted and perfected are serving in the war effort in thousands of ways.

In all classes of manufacture new materials or old materials, hitherto restricted in use, will be abundant. The aluminum capacity is being expanded three to four times the pre-war level, and similar expansion is taking place in magnesium. Synthetic rubber substitutes will be available in greater quantities. New steel alloys and heat treatments, particularly the inductive heat treatment of steel, which have been developed for defense material are going to be available for commercial use when the emergency is over. This huge productive capacity in peace times must force downward the costs of these materials and so make them available economically where the cost had previously been prohibitive.

For one thing, the airplane will definitely become a more vital factor in commercial transportation. The aircraft manufacturers are designing passenger planes with capacity for one hundred or more persons and are even now designing cargo-carrying planes for use in the

(*Continued on page 148*)

BETTER SAND FOR BETTER CASTINGS

TESTING AND CONTROL OF FOUNDRY SANDS REDUCES NUMBER OF DEFECTIVE CASTINGS

By PROFESSOR PETER E. KYLE

IN the development of the foundry industry, the problem of defective castings has always been a serious one. These defects may be due to such factors as improper molding technique, poor mixing and melting of the metal, bad design, improper gating, bad pouring practice, and improper molding sand conditions. Of these, more attention has been focused in recent years on improving the design of castings and on control of the sand condition in a mold. It is to this latter subject that the remarks which follow will be related.

The foundry of the early days depended almost entirely for its success on the molder, who was a tradesman, skilled in the manipulation of molding tools and sand. At this stage, the preparation of sand was usually to the liking of the master molder as an individual, although the manual labor involved was usually done by an apprentice. The feel of the sand as it was squeezed in the hand was the only measure of sand condition. At the present time this same condition still prevails in many foundries, particularly those of the small jobber.

It soon became evident, however, that many of the irregularities in casting production could be traced to improperly prepared sand. This was particularly true at the advent of the production type of foundry where uniformity in repetitive castings was essential. In this country the seriousness of this problem was recognized in 1921, when the American Foundrymen's Association started a coöperative study on testing of foundry sands which later resulted in the formation of the A. F. A. Committee on Sand Research. The work of this group has, in addition to other things, resulted in the development of standard tests for sands which are now very widely used both here and on the European continent. The tests in most common use today are moisture content, clay content, fineness, permeability, and strength. By the proper control of these properties, many casting difficulties have been eliminated.

Molding sands are composed essentially of a suitable grade of silica sand grain and the proper amount and quality of some bonding material which is usually a form of clay to which water is added. In some deposits, such as in the Hudson River and Albany districts, the sand and clay are found mixed in approximately the optimum percentages, and these sands are very convenient for the work in many foundries, particularly in the small castings field. For other applications, it has been found that best results can be obtained from washed and screened silica sand grains to which the proper amount of clay has been added. Sands prepared in this manner have been given the name "synthetic sands," although none of the constituents are synthetic in nature.

Professor Peter E. Kyle received his degree in Mechanical Engineering from Cornell University in 1933. Following graduate study at Lehigh University, he joined the staff of the Massachusetts Institute of Technology in September, 1934, as Assistant in Mechanical Engineering, and in 1939 was given the degree of Master of Science. He is now an Assistant Professor of Mechanical Engineering at M. I. T., where he is in charge of the Metal Processing Laboratories. Professor Kyle has done work with the Westinghouse Electric and Manufacturing Company of East Pittsburgh and has had wide industrial experience as a consultant on processing problems for various other concerns.

In creating a bond between sand grains, the amount of moisture present governs to a certain extent the strength which the sand can develop. Based on the quantity of clay present, there is an optimum moisture content which will give best strength, and any amounts greater or less than this optimum will result in lower strength. For this reason, it becomes very desirable to measure the moisture content of sands during preparation for molding and at frequent intervals while the sand is on the molding floor in heaps. This control test for moisture is performed more often than any of the others mentioned above. The primary purpose is for control of sand strength, but of secondary value is the maintenance of a minimum amount of steam in the mold during and just after pouring. The test itself is usually made by the ordinary weight reduction methods.

The clay content of sands is measured by a flotation process whereby particles whose settling rates in water are less than one inch per minute are classified as clay. Each sand requires an optimum amount of clay, and control tests are usually performed periodically to check on the amount lost by burning during the pouring of the castings. The effect of clay loss can also be detected by the drop in strength value in compression, but in order to properly plan for clay additions, the actual percentage has to be obtained.

Fineness in molding sand is important from the standpoint of developing suitable smooth surfaces on the casting consistent with the required permeability in the mold itself. This property is measured on sand grains only by means of a set of United States Bureau of Standards' sieves. It is possible to express fineness

(*Continued on page 152*)

THE TECH ENGINEERING NEWS is indebted to Mr. Frederick R. Evans, Instructor in Metal Processing at M. I. T., for the photographs used in this article.

SINK OR SWIM

FLOTATION, CONSERVER OF NATIONAL RESOURCES, MAKES USE OF PREFERENTIAL ADHESION

By CURT B. BECK, '46

WHEN Herodotus mentioned the practice of using a feather dipped in oil to separate gold dust from river bottom sand, he little dreamt that he was describing the forerunner of a process which today has promise as great if not greater than any other branch of the field of metallurgy, flotation. To the uninformed, flotation is the process of causing certain mineral products to be separated from an aqueous suspension either by floating to the top or sinking to the bottom. It is one of the most important methods for processing and refining a majority of the minerals which are extracted from the earth in any significant quantity. Since all minerals extracted from the ground occur with varying amounts of impurities, the separation of these impurities is one of the primary tasks of ore treatment; flotation, until recently an undeveloped and immature branch of mineral treatment, is today realizing its potential significance in metallurgy and is proving its value both by accelerating war production and by developing metal extraction into a more efficient and fruitful process.

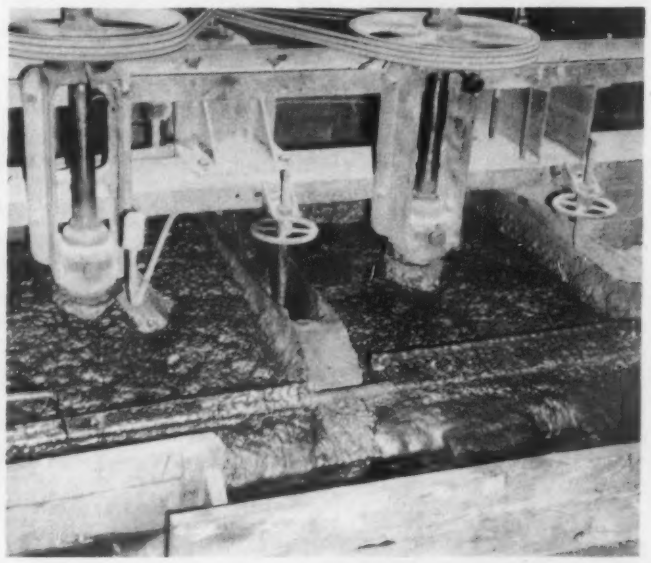
Flotation in a form closely resembling its present one was first practiced by the Persians. A method of purifying minerals by selective adhesion to a mixture of oil and water was mentioned in a Persian document written in 1492. From that date until 1890, flotation was regarded more as an unimportant phenomenon than as a practical and useful tool, and the little that was done on its development was done in the laboratory. However, in the early 1900's, the first practical flotation plant was set up in South Wales to concentrate gold and silver ores. In 1911, the first plant in the United States was opened in Butte, Montana, to treat lead-zinc ore, and since then this process has grown until now it is one of the most efficacious methods of ore concentration and dressing known to the mining profession.

A brief outline of its main principles will give the reader a working knowledge of this process. When a finely divided solid, such as an ore or an earth, is placed in water containing a small amount of one or more reagents of certain types, and the mixture agitated, specific constituents of this solid will stick to the bubbles produced and will form on top of the liquid a froth which can be scraped off. On this seemingly insignificant effect hangs the entire field of flotation, for by regulating these flotation reagents and the composition of the water solution almost any mineral constituent of an ore can be made to either sink or float.

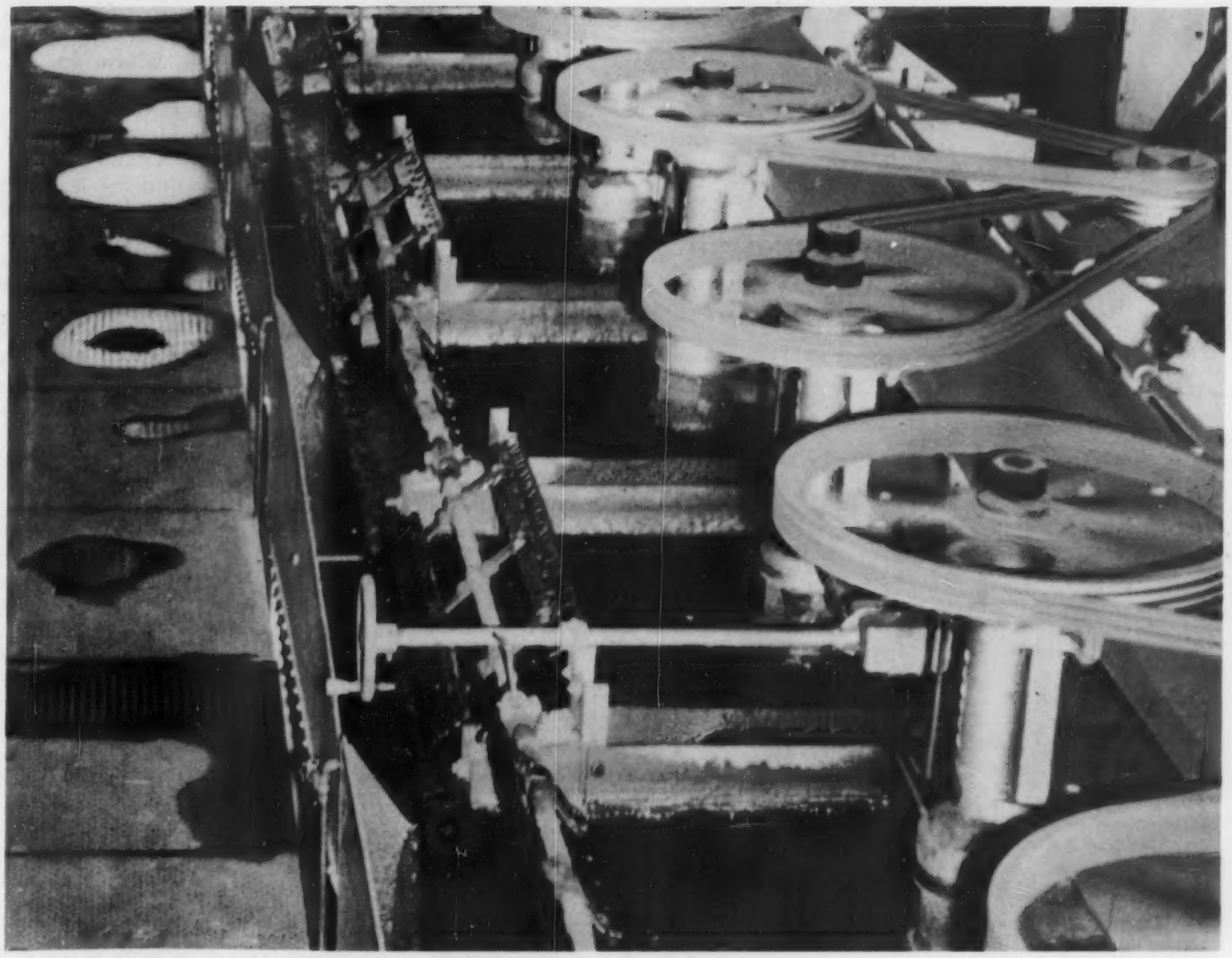
Curt Beck is a Freshman at Massachusetts Institute of Technology and comes from Dallas, Texas. He graduated as Valedictorian of his class from the Texas Country Day School in 1941, and again from the Phillips Exeter Academy in 1942. He plans to take Chemical Engineering at the Institute, subject to the decision of his draft board. His main interest is Chemistry, and his activities here at school include participation in Crew and being on the Editorial Staff of THE TECH ENGINEERING NEWS and the Literary Board of *Voo Doo*. He is a member of Alpha Tau Omega fraternity.

The flotation process was first applied to oil and water mixtures. Large amounts of an oil were agitated in contact with a mineral, with the hope that the desired mineral constituent would either be left behind or be found in the oil. This method was both expensive and uncontrollable. Workers soon found out that only a small amount of oil was necessary, and eventually specific chemicals were developed which were needed in comparatively small quantities.

Perhaps the most important and one of the most interesting parts of flotation are the flotation reagents, for the most part strange and complex chemicals which determine which of the mineral elements sink and which float. So thorough has been the research in this field that only about two dozen specific reagents are needed, although literally thousands have been investigated. Their application is highly specialized, and in most cases less than one pound of reagent is used per ton of ore treated. To quote an example: in the concentration of gold ore by flotation, the addition of two drops of pine oil per ton of feed increased the grade of a certain flota-



A closeup of two copper flotation cells. The center drive-rods attached to the belt and wheels agitate the suspended copper ore, creating the ore-bearing foam which overflows into the trough in the foreground. The pneumatic air source is not visible in this view. *Denver Equipment Company*

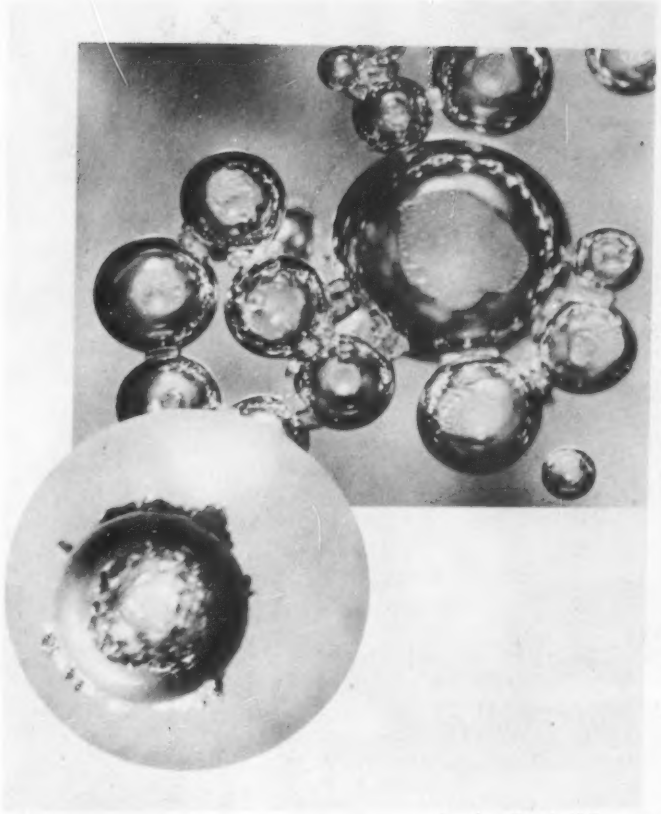


A battery of flotation cells in an iron-ore flotation plant *Denver Equipment Company*

tion product by $13,000 per ton. In general, reagents can be divided into seven groups, namely: collectors, frothers, dispersers, activators and deactivators, depressors, and protective agents. Collectors coat the mineral particles with a water-repellent film, causing them to float on the water surface in the same way as a duck's feathers cause him to float; frothers create the foam to which the particles adhere; dispersers reduce the colloidal formation and prevent flocculation, both of which might harm the action of the flotation cell; activators affect the surface of the mineral to be floated, increasing its power to pick up the collector, while deactivators do just the opposite in cases where such action is needed when ores are to be floated twice; depressors prevent undesired constituents from floating; while protective agents precipitate from solution undesired salts. Through experiments with reagents it has been learned that any type of control can be practiced on the ore. Moreover, nearly all common chemicals have some use or can in some way be used in flotation, as well as many uncommon organic compounds.

The mechanical aspects of flotation can be dismissed, for the purposes of this story, in a paragraph. Very finely ground ore is introduced into a cell such as one shown in the accompanying picture, and the reagents needed are added to the suspension, or pulp. By a combination of mechanical agitation and air bubbling, the solid is brought into suspension and the resultant foam skimmed off as shown in the picture. Either the foam or the sediment is then rejected as the tailings, and the product may again undergo flotation, this time with different reagents and under different conditions.

The modern era of flotation dates from around 1920, when the alkaline circuit (flotation in an alkaline solution) was introduced. Until that time flotation was limited to the separation of all the sulphide ores, namely gold, silver, copper, lead and zinc sulphides, together, from their gangue or waste constituents. Reagents were limited to the fatty acids, such as oleic acid for example, and their selection was more or less of a hit or miss proposition. Natural graphite and coal dust were the only non-metals of any importance which were refined by flotation, but since the advent of sulfidizing and the use of alkaline circuits and organic collectors, the progress of flotation has been rapid indeed. The process of sulfidizing (adding sulfide to the flotation mixture or pulp) causes the oxide particles to be coated with the corresponding sulfide, and consequently to be floated more readily. The alkaline circuit, now almost universally used in flotation cells, depresses unwanted salts, neutralizes acid mineral waters, hastens settling, and increases frothing properties. In recent times many other ores have joined the list of those beneficiated by flotation. Manganese, tungsten, molybdenum (all of the country's molybdenum ore is now concentrated by flotation) vanadium, platinum, cobalt and innumerable other minerals are treated by flotation. The concentration of the ores of lead, zinc, and the rarer metals has become and continues to be increas-



American Cyanimid Company

A much-enlarged picture of actual flotation bubbles. The irregular areas on the bubbles are ore-particles being carried to the surface. The entire flotation process depends upon this one effect.

ingly more efficient. This trend is well represented by copper, which is now completely concentrated for smelting by flotation. Even though recovery of the concentrated copper sulfide from the ore has always ranged from 90 to 99 per cent since flotation was introduced, in many recent cases costs have practically been decimated. This has become possible by more efficient apparatus and better methods of conditioning the ore for flotation.

One of the most striking trends in flotation, according to Professor A.M.Gaudin of M.I.T., who is one of the world's foremost authorities on the subject, is the trend to non-metallic ore treatment. This trend has taken place during the last fifteen years, and can be graphically illustrated. As mentioned before, up to 1925, flotation was mainly practiced on the sulfides of gold, silver, lead, zinc, and other rare metals. About 1928, however, industry began to take notice of the very promising research being done on the concentration and beneficiation of non-metallic mineral products by flotation. The research was taken up by the metal smelting and refining companies themselves, and today, after a period of development of scarcely fifteen years, non-metallic ore flotation is becoming as important as metallic ore concentration and dressing.

Of all the non-metallic ore treatment processes, cement ore flotation is one of the most important. Prior to the application of flotation to cement manufacture, cement rock mining was a selective affair. Cement consists mainly of the oxides of silicon, aluminum, calcium, and iron. The proportions of these products must be carefully controlled in the final roasting, and this operation required difficult and expensive procedures until recently.

However, in 1934, when six million barrels of cement were needed for the great Shasta dam in California, a flotation process was developed which revolutionized the industry. By selective flotation it is now possible to remove the unwanted products, here minerals such as calcite, mica, quartz, feldspar, muscovite, dolomite, and limonite, and control the concentration of the necessary oxides, iron, silica, aluminum, and calcium. In this process the rock is ground to minus two hundred mesh (less than four hundred particles to the inch) and the coarser sizes are subjected to rough flotation with a fatty acid, a collecting agent, and a frothing agent. The micas and pyrites are then concentrated by a cationic reagent. (Cationic reagents are comparatively new in flotation, having been introduced in 1933. The anionic part of the reagent molecule is still the part that is most important.) Using this process, the engineer is now able to mine a whole mountain or field for cement, in place of working rich sources only, as was formerly done.

Another striking example of the application of flotation to non-metallic ores is phosphate rock flotation, now the largest non-metallic ore flotation branch. The purification and beneficiation of phosphate rock, until 1930, was a difficult and wasteful process. At that time the leading phosphate companies took up flotation, with very gratifying results. In one Florida phosphate plant, for example, the ore yield was stepped up from 4000 to 8000 tons per acre. At the same time costs were cut 55 cents per ton of ore treated. In another mining camp the yield was increased from 2000 tons of 68 per cent phosphate to 13,000 tons of 74 per cent phosphate per acre mined, an increase of almost sevenfold! It is easy to see why phosphate flotation is now one of the most important branches of the industry.

The ceramics industry is another of the non-metallic ore flotation branches. Nearly all the materials used by this industry are extracted from the ground and have to be separated and graded. Mica, kaolin, quartz, silica sand, gypsum, and talc are only a few of the many materials that must be purified and must have their concentration controlled. Each one of these products is now refined at least in part by flotation, and all of these purification processes were developed in the last ten years.

Even the coal industry is served by the process. Coal flotation involves separating the fine coal dust or tails from the water coming from the coal washing process, and serves the dual purpose of eliminating an enormous coal waste and preventing stream and river pollution. It originally consisted of agitating the fines with oil and either using this coal-oil mixture as a fuel or attempting to reclaim a part of the oil for use again, but now coal is floated with specific reagents.

Before 1933, according to Dr. Erwin W. Mayer of Berlin, there was only one coal flotation plant in the United States and sixty in Europe. Now that American industry has become waste conscious, coal flotation should become a widely used process, but lack of a market for the dust (it is made into briquets and sold as a compact and popular fuel in Europe) and other factors have prevented coal dust flotation from being important in the United States.

The most important application of flotation is still to metallic ores. It has come into the metallurgical limelight in recent times. Metals are wanted more than ever before at present, and are wanted immediately. With many of the usual sources in the theater of war or else cut off by the war, domestic ores are being thoroughly investigated. Ores which heretofore were considered commercially impossible to work are now being concentrated for all the metal they contain, be it ever

(*Continued on page 147*)

FINAL EXAM

GRUELING TESTS INSURE TOP PERFORMANCE OF AMERICA'S AIRCRAFT ENGINES

By ARTHUR M. SCHEERER

THE Maorian natives, when they were the leading cannibals of the antipodes, had an effective means of testing the claim of a lad that he was of age to be a warrior; they painted the young buck white, gave him a few hours headstart into the bush, and then hunted him for two weeks, death being the penalty if caught, since his capture convicted him of being unfit for the tribe. Today, on the other side of the world, the American aircraft companies are putting each aircraft engine through a test procedure which, in its own way, has the same ruthless objective, that of approving only quality.

When a 1700 horse power Wright Cyclone 14 emerges from its plant, on its way to installation in a North American B-25, Curtiss Helldiver, Grumman Avenger, or any other one of the dozens of American planes in this World War II, it represents the result of 80,000 machining operations and 50,000 inspections. The test runs are the most searching and thorough of all these inspections.

Each Cyclone is put through a four-hour preliminary run, commonly called the "green" run. Then it is disassembled and every piece inspected individually. Once more the Cyclone moves down a progressive assembly line, then goes back to a test cell for a final run of two and one-half hours. If it meets all specifications, it is prepared for packing and then is shipped to point of installation.

This test procedure is adopted to run-in the engine, check its carburetion and ignition and determine if it meets all requirements and guarantees, not only from the standpoint of power output, fuel and oil consumption, and operating temperatures and pressures, but also from the standpoint of bringing out any mechanical weaknesses or flaws which would be in any way detrimental to the engine's service life. Engine builders can never forget that the first thing an engine is called on to do in operation is to develop its maximum permissible horse power for a take-off.

Two workers installing a four-bladed wooden propeller on a Cyclone aircraft engine about to start its preliminary test run. This type of wooden propeller, known as a "test club," not only absorbs engine power and holds down the speed to prescribed limits, but also cools the engine. Note the extra broad blades, set at a 45-degree pitch. Flight propellers are not adequate for cooling on tests, since the greater part of the blade area extends beyond the engine cowling. *Wright Aeronautical Corporation*

The typical production test cell is 14 x 14 x 60 feet, of concrete construction, with a sound proof control room adjoining. The engine is mounted in a barrel-shaped stand, which in turn is anchored firmly on four legs tied to cross members imbedded in concrete. A sealed carburetor air intake pipe leads down from the ceiling, while a streamlined service duct from the control room wall to the barrel-stand carries feeder lines and controls. Most of the cells are of the twin-tower U-shape, that is, cooling air comes down through a vertical shaft or tower at one end of the cell, sweeps across the engine, and is exhausted through a similar tower at the far end of the cell. These towers are constructed of a porous-block material, put together in a grid or baffle arrangement for sound absorption.

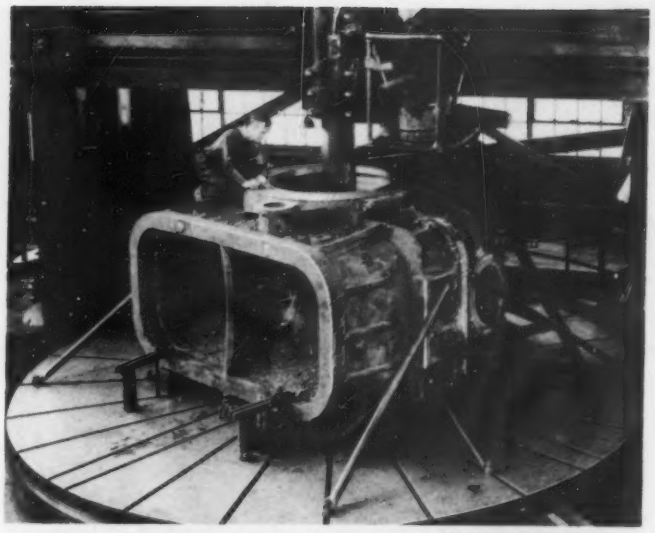
The control panel of a cell not only contains all the instruments necessary to a pilot in measuring engine performance in flight, but also the additional pressure gauges and thermocouples necessary for specification tests, including such equipment as scales for indicating oil consumption and rotometer to measure exact fuel consumption at any horse power level.

In the standard production test, the engine is

(*Continued on page 148*)

Mr. Scheerer is a native of Fort Dodge, Iowa, and after attending grammar and high schools in his home city received his B.S.M.E. degree from Iowa State University in 1934. Prior to that time, however, he had put in five years as a pilot and flight instructor. He joined the Wright Aeronautical Corporation in 1936 and went to work immediately in the test house. At the present time Mr. Scheerer's work includes supervision of all types of experimental testing at Wright Aeronautical, ranging from single cylinder test stands to full-scale test of new and as yet unannounced engines.

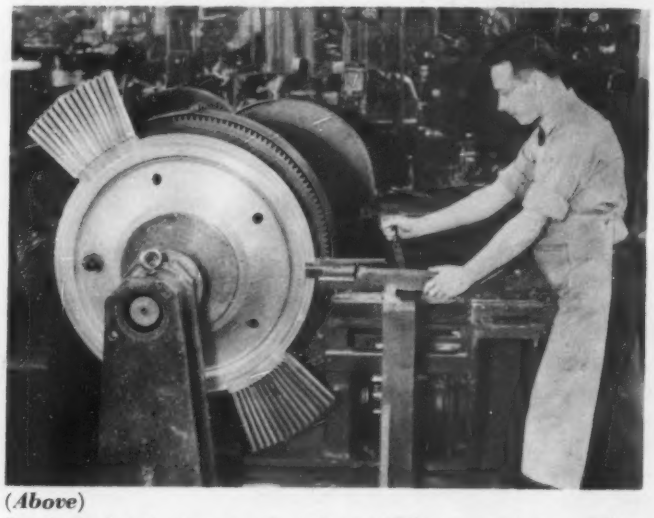
TURBINE PRODUCTION



(*Left*)

Because of their ability to withstand pressures and temperatures that are often high and subject to wide variation, turbine casings are impressive in their strength and rigidity. Materials are carefully selected for the temperatures involved, and the pattern work and foundry practice are highly specialized. This is particularly evident in the manufacture of the casings of certain noncondensing units and of those arranged for various combinations of extraction and admission. Steam chests are cast integral with the high-pressure section of the turbine casings. The liberal use of webs and fillets adds to the strength and soundness of the castings.

Properly designed supports allow free expansion and contraction with changes in temperature. Accurate machining provides steam-tight joints for the diaphragms, valve seats, and other steam parts. Steam-tight casing joints are maintained by a metal-to-metal seal secured by means of heavy flanges and flange bolts.



(*Above*)

Turbine buckets are of substantial proportions. They are usually either forged or milled from solid stock. Special materials, selected for their strength and resistance to erosion and corrosion, are used. Bucket shapes are accurately formed, and their surfaces are smoothly finished.

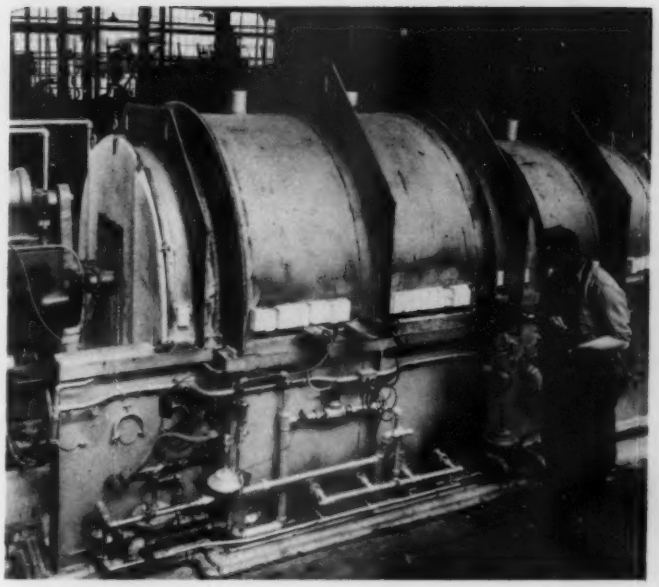
(*Below*)

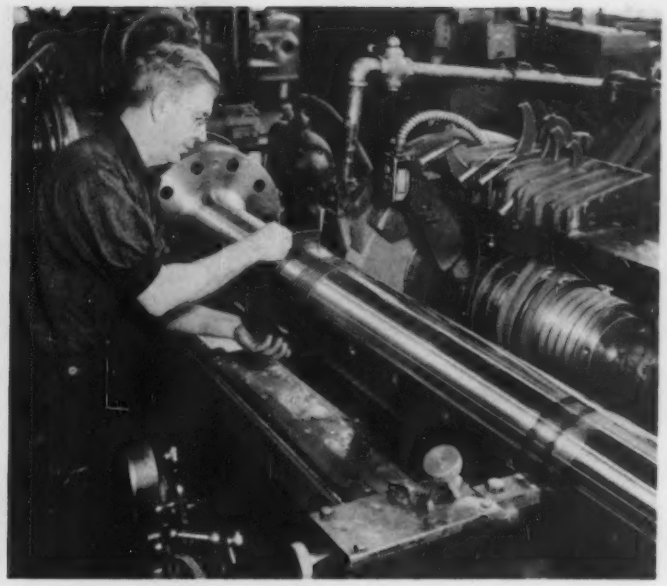
The carefully made dovetails secure the buckets to the wheel. Assembly is accomplished by the use of special bucketing machines.

(*Above*)

Based on research and experience, the design of the main and thrust bearings contributes much to the dependability of operation. The spherical seated, self-aligning, main bearings are pressure lubricated from the turbine oil pump. Proper grooving of the babbitt lining assures the maintenance of an oil film and allows a liberal flow of oil for cooling the bearings.

The axial position of the turbine rotor is maintained by a thrust bearing unique in its simplicity and effectiveness. This "tapered-land" bearing, developed by General Electric engineers, consists of stationary babbitt-faced plates grooved to provide oil passages, and either one or two accurately ground shaft collars. The faces of the plates between which the collars rotate are so tapered that oil is continually trapped and forced between the bearing surfaces.





(*Above*)
Selected billets are forged, heat-treated, and machined, to form the turbine shafts. Included in the forging is the coupling for connection to the generator. The complete shaft, including the journals, is accurately ground to size, close tolerances providing accurate fits for the bucket wheels.

(*Below, left*)
Of special interest is the heat test applied to every shaft. In this test each shaft is slowly rotated in an oven maintained at a temperature well above the temperature to which the shaft will be subjected during operation. Every shaft is required to run true at both high and low temperatures to assure its running true in service.

(*Right*)
Construction of the turbine wheel is completed by enclosing the steam passages with a shroud band which is hand-riveted to the tips of the buckets. Skilled workmen carefully form each rivet head so that the shroud band is held firmly in place. Each wheel is statically balanced prior to being mounted on the shaft.

Pictures from General Electric Company

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PROSPECT AND RETROSPECT: AN EDITORIAL

With this issue, the TECH ENGINEERING NEWS closes Volume XXIV. It is not without regret that the Managing Board departs, but they can leave with the knowledge that they have done their job well. As they go to enter the armed service of their country, those who remain wish them Godspeed and express the wish that we shall be able to carry on in the best tradition of the TECH ENGINEERING NEWS, which they have so well upheld.

However, it is not only the Managing Board which will leave. In all probability the many members of the Junior Board and Staff who are reservists will follow them shortly, so that relatively few of the present staff will remain.

It is this impending shortage of trained personnel which has forced the TECH ENGINEERING NEWS to lay aside its present organizational set-up, at least temporarily, and establish a T. E. N. Executive Committee, which is charged with the responsibility of assembling, during the summer, a sufficient staff to enable the magazine to resume publication in the fall. The Committee takes up its duties with the promise that it will make every effort to bring you the next issue on schedule, next October. But it is not the purpose of the Committee to publish just anything in order to perpetuate the name of the TECH ENGINEERING NEWS; future copies will be up to standard or they will not be issued at all.

This is not just a hollow promise, for, since its inception in 1919, the name of the TECH ENGINEERING NEWS has commanded respect in the field of undergraduate scientific journals, and it is our sincere belief that a substandard publication is worse than none at all.

Through the years T. E. N.'s influence on other college scientific magazines has been very pronounced. During the second year of its existence, the TECH ENGINEERING NEWS founded the Engineering Colleges Magazine Association. Today the E. C. M. A. is the adviser and guiding hand of many of the country's undergraduate scientific journals with its purpose now, as when it was founded, to standardize and maintain at a high level the form, general characteristics, and content of its member publications. To further this end, the E. C. M. A. holds annual competitions for excellence in the various departments of the magazines, such as editorials, editorial content, cover designs, and typography. As an additional stimulus, the TECH ENGINEERING NEWS has offered, each year since 1937, the T. E. N. Cup, awarded for general excellence to the year's outstanding college scientific publication, but because so many magazines have had to suspend publication due to the war, the award has been discontinued for the duration.

It was intended by the founders that the T. E. N. should be a link between past and present students by bringing before the school the accomplishments of prominent graduates, engineers and business men, as well as to increase technical knowledge in general by publishing interesting and significant developments in the field of contemporary science.

Our pace may be slowed, but our standards are set and our goal unaltered.

Saved! Tons of tin!

For years telephone cables have been spliced in a very satisfactory way. But the solder joint contained 40 per cent war-vital tin.

So Bell System men devised a new type of joint which saves up to 80 per cent of the solder. A "Victory Joint" they called it.

The new technique has been adopted throughout the System with the result that 600,000 pounds of tin and an even greater amount of lead can be saved in a normal year's construction.

This is another example of the nation-wide cooperation of Bell System people in fulfilling their ideal —service to the nation in peace or war.

LUFKIN "ANCHOR" CHROME CLAD
STEEL TAPE Here's a sturdy, easy-to-read quality tape you will appreciate. Surface won't crack, chip, rust or peel. Genuine leather cover on steel case. Smooth winding mechanism. See it at your dealer and write for catalog.
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national program of urban reconstruction? According to the 1940 Census, there are nearly 35 million occupied dwelling units in the United States, of which 20 million are in urban places with a population of over 2500. More than half this number, about 10,500,000, are located in cities with a population of at least 100,000. Studies of family incomes made several years ago by the National Resources Planning Board showed that 55 per cent of urban families living in cities with over 100,000 population had incomes of $1500 per year or less and paid no more than $35 per month in rent. There is little doubt that a majority of these five or six million families lives in obsolete dwellings and still more obsolete neighborhoods, but the magnitude of our task is seen when we try to apply our figures for the costs of reconstruction to the improvement of living conditions for such a large segment of the population. It is a tremendous undertaking, even though it represents only one-seventh of the nation's families compared to the one-third which we have been told are "ill-fed and ill-housed."

Rehousing five million families in new dwelling units with no provision for improved neighborhood facilities other than those immediately related to the buildings themselves would involve an expenditure of about 25 *billions* of dollars. This is a quarter of the national income which our economists tell us should be considered a minimum after the war if we are to maintain full employment. In addition to this capital expenditure, assessed valuations amounting to seven or eight billion dollars would be wiped off the tax books if the program were on a public subsidy basis. On the other hand, the cost of substantial improvements in neighborhood design — including the provision of adequate open space and a reduction in excessive population density — *should be possible for these same five million families at a cost of two billion dollars*, of which a little more than half would represent the accompanying reduction in the tax rolls. In either case the magnitude of the program is such that it would have to be a long-term coöperative effort of public and private agencies in which the Federal government would presumably be called on to play a part.

REHOUSING *VS.* REHABITATION

(*Continued from page 131*)

structures in this same area would present a bigger financial problem. We do not know what building costs will be immediately after the war, but it is unlikely that new methods of constructing fireproof multi-family housing will be developed in the near future to bring post-war prices down much below those prevailing in 1939. In that year the best that public or private agencies were able to do for this type of housing was $800 per room excluding the land, or about $3200 per dwelling unit, and we would certainly be open to an accusation of wishful thinking if we adopted any lower figure.

Land costs per family would of course vary considerably with the cost of land per square foot and the number of families which were housed per unit of land area. The average density of new housing projects in all cities should certainly not exceed 40 families per net acre (a lower figure would be highly desirable), but even at this density each family would have to carry the cost of over 1000 square feet of land. At $1.50 per square foot, this would bring the minimum cost of land and building per family to $4700.

Thus we see the cost of rehousing is over ten times the cost of neighborhood rehabilitation in areas of similar land cost, and there is good reason for believing that housing costs would be higher and redevelopment costs lower than those given above.

A National Program of Urban Reconstruction

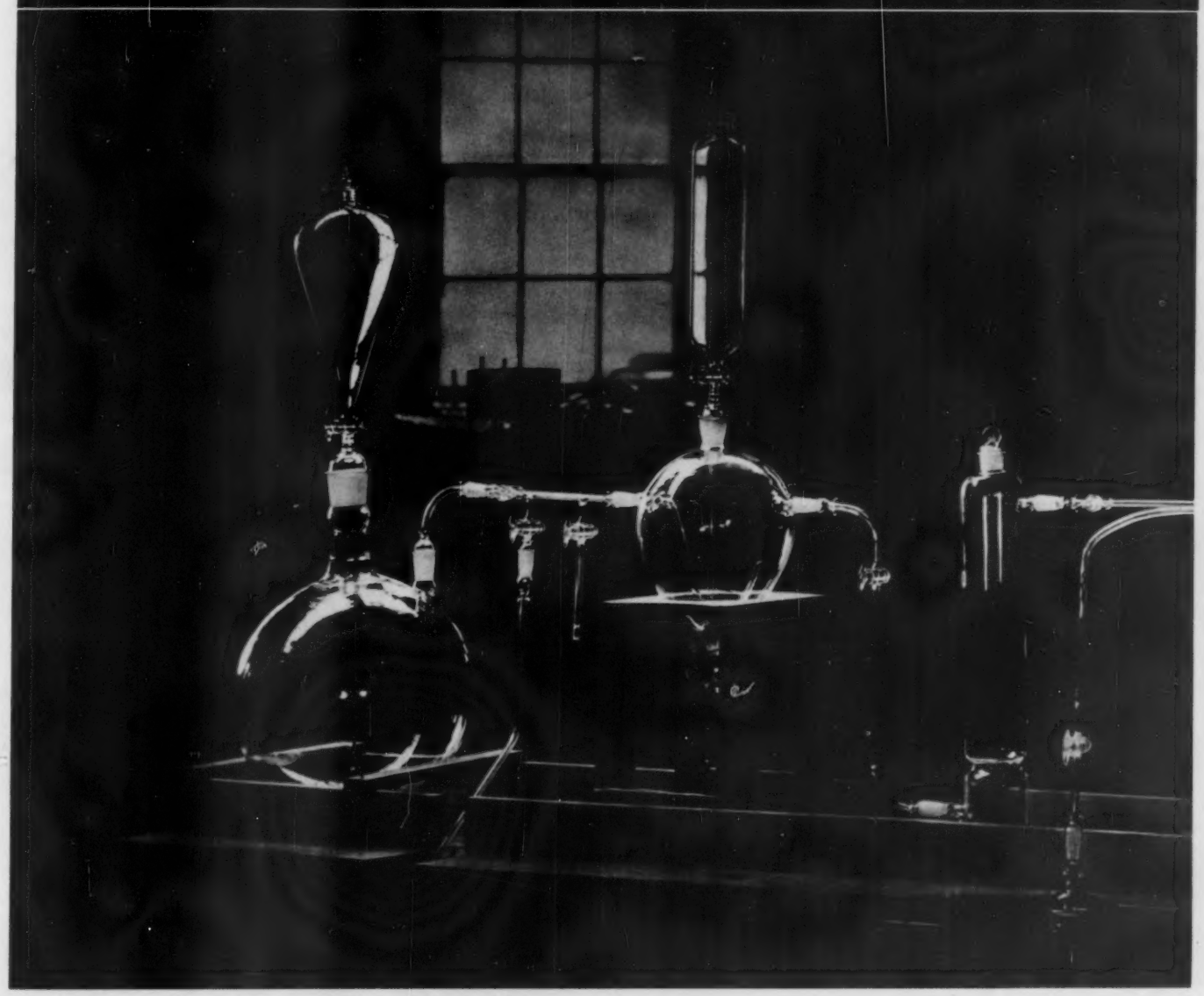
What are the implications of the above figures when we try to visualize the scope and magnitude of a

What of the Future?

Let us recognize the fact that the above cost estimates are approximations only, especially in so far as they relate to expenditures for land acquisition. This item alone is nearly one-third of the cost of the housing program and over half the cost of the redevelopment program. It might represent a higher proportion in some of our largest cities. But even if we ignore variations in land or building costs we are faced with an all-important question which is frequently given no consideration whatever in post-war housing plans. That is, should we consider investing large sums of money — whether the funds be from public or private sources — in permanent and expensive residential structures if they are to be located in obsolete neighborhoods? Our studies so far indicate that a sounder policy would be to embark on a program of slum clearance and the redevelopment of residential neighborhoods, providing at the start new housing *only* for those families which were displaced by the redevelopment scheme, until those neighborhoods which were worth rehabilitating (*i.e.* were suitable for continued residential use) have been brought up to a reasonable minimum standard. At the conclusion of the latter program we would then be in a position to consider the extent to which new structures could be built to replace the remaining hous-

(*Continued on page 147*)

Neither too little nor too late, Dr. Goebbels!



IT'S fashionable in some quarters to talk of America as a nation that lets clever people like the Germans run circles around it in technical skill. We have a hunch the idea comes from Dr. Goebbels' propaganda factory in Berlin. Anyway, it's not true.

In the glass field, for example, America was surprisingly well prepared for war. Take Laboratory glassware, vital in the manufacture of dyes, explosives, foods, and many war supplies, as well as to health. In 1914 we depended upon Germany for this material. But in 1915 Corning developed Pyrex brand laboratory ware and now this country needs German glass no more than it needs German wheat!

Despite war's demand, Corning is keeping pace with laboratory ware, insulators, communication equipment, and signal glassware required for planes and ships. Chemical industries are getting necessary quantities of glass piping, acid pumps, and glass mechanical parts that replace scarce metal alloys. Even glass precision gauges (ring, plug and others) are now being produced that are in many ways superior to ones made of steel.

These are just a few of the war-important items flowing out of Corning today. The main point is that when the national need arose, Corning research had already explored the things that non-critical glass could do to replace materials vital to war effort and was ready to help. Yes, to the engineer glass is really important today, and promises to be more so after the war is over. That's why the best advice we can think of for you is this: Keep up-to-date on glass! Corning Glass Works, Corning, New York.

"YOU HAVE DONE A GOOD JOB OF SENDING GLASS TO WAR"

CORNING
means
Research in Glass

"The most fascinating business in America"

The unlocking of the treasure house that lies sealed in a lump of coal has been called the most fascinating business in America. It touches every industry. That is why Koppers has been called the industry that serves all industry. Here are some materials which Koppers supplies to the chemical industry .... which is only one of dozens of industries it serves in comparable manner. Koppers Company and Affiliates, Pittsburgh, Pa.

KOPPERS

THE INDUSTRY THAT SERVES ALL INDUSTRY

SINK OR SWIM

(*Continued from page 138*)

so small. Waste piles from industrial processes are being reworked for their few-hundredths of a per cent of valuable mineral compound. Much of the part flotation is playing in this phase of winning the war is kept secret, but the general trend of affairs is fairly well known. Here is a compilation of recent developments in the field of valuable metal reclamation.

TIN: At present, the problem of tin ore concentration is occupying a major portion of the attentions of flotation researchers. Tin has long been considered the one metal whose loss would be felt more by the United States than the loss of any other metal, and such has been the case with Japanese occupation of Malaya and the Dutch Indies. Bolivia is now providing a large portion of our tin, but this source is sadly insufficient. As a result, waste products containing less than one per cent by weight of tin are being intensively investigated for flotation. By the time of printing this problem may be solved, but cassiterite (native tin oxide) and tin ore flotation has remained as an unsolved but much investigated problem up to the present date.

MANGANESE: Our entire manganese supply, estimated at around 1,250,000 tons of high-grade ore annually, came formerly from the U. S. S. R., Africa, India, Brazil, and Cuba, but these sources have been cut off or threatened by war. As a result, Anaconda has been developing low-grade American ores, and their Butte mines are now concentrating 20 per cent ore into a 40 per cent product, which is in turn roasted to give a 60 per cent product. The capacity of their plant is said to be 1000 tons per day, a big help to industry's need.

Numerous other metals can be included in this list. Chromium, aluminum, nickel, and vanadium are being investigated and are being concentrated by flotation at present. In connection with nickel flotation, an interesting discovery was made by some researchers working on the problem of separating certain constituents of the tails from an asbestos refining process. Flotation of the product under certain conditions brought to light that the asbestos waste contained particles of metallic nickel, which could be floated out conveniently and whose presence had not been at all suspected. It is not often that the research worker is rewarded by such a find.

Another interesting application of flotation is in reclaiming waste metals from machining operations. The sweepings from plants where a large amount of machining is done are now floated, even to the degree of perfection whereby the different metals in the waste are separated. This presented a small side problem to the flotation engineer, since much of the metal thus obtained is covered with oil and machining compound, and the adhesive and binder used in the wheel has a tendency to float out very readily with other constituents. A combination of pine oil, sodium hydroxide, fuel oil, and an organic reagent solved the problem of which reagents to use.

As can be deduced from the foregoing material, flotation is potentially a great field, and at present is extremely important in metallurgy. It has the advantage of simplicity over other milling operations. Flotation concentration reduces transportation costs and simplifies smelting operations. It conserves national resources and saves thousands of tons of metal ores every year. Many fields, such as the refining of iron ore, to quote one small example, are due to be taken over by flotation in the not-so-distant future. Watch the ore float by, for that is the way it is going to market!

The latest figures announced by the U. S. Maritime Commission indicate that more than 44,000,000 tons of NEW ships will be put in operation by the end of 1944—many of them with B&W Boilers.

When this Bridge Across the Atlantic has served its vital war-time purpose and these ships return to normal pursuits, B&W will be in a better position than ever before to serve you who choose the power industry as your life's work.

B&W workers are proud of the three Army-Navy "E"'s and the Maritime "M" which fly over their plants.

THE BABCOCK & WILCOX COMPANY.... 85 LIBERTY STREET.... NEW YORK, N. Y.

BABCOCK & WILCOX

REHOUSING *VS.* REHABITATION

(*Continued from page 144*)

ing accommodations which were substandard or outmoded.

There are social as well as economic reasons for accepting this conclusion. The future of the city as a residential area of importance is hanging in the balance. The post-war implications of technological changes now taking place in airplane and automobile transportation and in building materials and methods of construction are still in the realm of prophesy, but they do not bode well for those who wish forcibly to stem the tide of decentralization. The redevelopment of blighted urban areas by means of the clearance of obsolete buildings and the construction and equipment of community facilities would not only be possible on a much wider scale than would the rehousing of low-income families in new buildings due to lower costs per capita, but it would also provide a much more flexible pattern of physical development for adjustment to future conditions.

The Field Station study of the costs of neighborhood redevelopment suggests that most of our blighted urban areas could be rehabilitated and over fifteen per cent of the families now accommodated therein could be rehoused in new dwelling units for about the same cost as rehousing twenty-five per cent of these families and *leaving the other seventy-five per cent to make the best of existing housing accommodations and neighborhoods, both of which are substandard by any reasonable yardstick.*

FOR Victory AND AFTER

★ ★ ★ ★ ★ ★ ★ ★ ★ ★

Our research to maintain and improve the quality of Simplex insulated wires and cables, under restrictions designed to save critical materials, is getting results that mean better insulated conductors for commercial use after the war.

Simplex Wire & Cable Co.
79 Sidney Street, Cambridge, Mass.

THE QUEST FOR POWER

(*Continued from page 134*)

future. On the ground, super-highways are beginning to cover the countryside.

Wartime developments are bound to have their effect on the transportation industry. To meet the competition of the airways and the super-highways, passenger speeds of a hundred miles per hour may be commonplace. Roadbed, alignment, .track structure and curvature must be modified to enable schedule speeds to more nearly approach the maximum speeds. Rolling stock will incorporate hundreds of new materials or new applications of old materials to give a smoother, less expensive ride. Locomotives must be capable of sustaining the required speeds over the entire profile.

In freight service, these developments will mean the operation of certain trains for high-class commodities operating on schedules approaching the best passenger speeds. Overnight deliveries of a thousand miles may be commonplace. This freight service will necessitate rolling stock and motive power of the same order as the best passenger service.

Unquestionably the railroads will see competition in the future from the developments now going on. This cannot be avoided. But this war has shown that the nation must have a well integrated transportation industry, in the forefront of which stand the railroads. The railroad supply industry is one of the main contributors to the war effort, and will be in excellent shape to contribute the super locomotives and the super-rolling stock to the super railroads of the future.

FINAL EXAM

(*Continued from page 139*)

equipped with a four-bladed wooden propeller. This "test club" must not only limit the engine speed and absorb its power but must also cool the engine. A flight test propeller would require a much larger cell and would also fail to cool the engine, since the greater section of the blade area is outside the diameter of the engine. The test clubs have a forty-five-degree pitch right on down to the hub, providing an ample flow of air over the engine. On flight propeller tests in the larger cells, some form of auxiliary blower is used to cool the engine.

Engine testers are required to pull all engines through at least two complete revolutions by hand before a start is attempted. Otherwise, the presence of any quantity of liquid in the combustion chamber is likely to cause serious damage. On the propeller equipped stands, engine testers must stop the engine if oil pressure does not reach forty pounds per square inch in ten seconds after starting. A horn above the instrument panel adds an audible warning until operating pressure is reached, and it will sound an alarm again if oil pressure drops below a specified level at any time during the test run.

In this connection, there is an old axiom to the effect that the most important item to be remembered when operating an engine at any load or speed is:

Watch your oil pressure.

For the initial test, or "green" run, the production engine is started under its own power and stabilized at 45 per cent of its rated speed on propeller load. Then by gradual increases, according to the test specification for that engine, it is subjected to a test schedule at its speed and output ratings. A typical schedule is as follows:

Run-in one hour up to 84 per cent normal rated horse power.

Run one and one-half hours at 95 per cent normal rated horse power.

Run one-half hour at 100 per cent normal rated horse power.

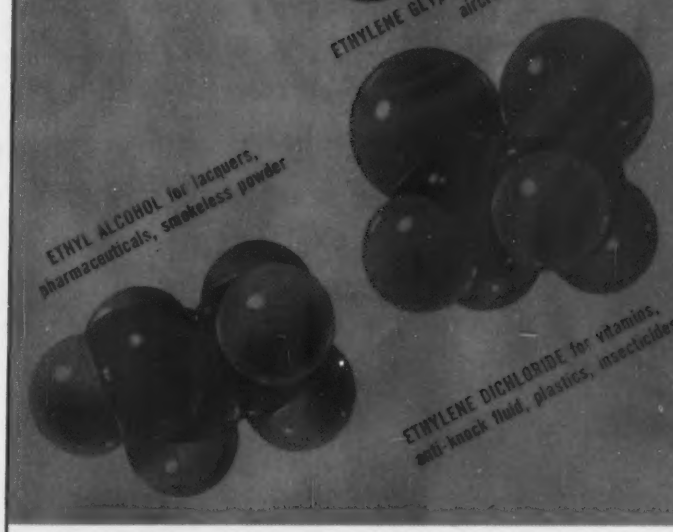
In addition, if the engine has a take-off power rating different from its sea level rating, it is given a five-minute idle rest period and then subjected to 50 minutes of take-off and idling, alternately for five-minute intervals.

The final test consists of a running-in period and a final acceptance test. During the running-in period, which lasts one hour, the fuel metering characteristics are also determined from 45 per cent speed to 95 per cent speed, in order to make sure that the fuel metering is adequate for the sustained power runs of the final acceptance test which follows immediately.

The final acceptance test consists of a half-hour at 95 per cent speed and 85 per cent output, followed by a half hour at rated speed and rated output. This is followed by a check on magnetos, idling, and acceleration, with a check on the operation of the carburetor idle cut-off. For the final test, a demonstration at take-off manifold pressure and speed is required.

During the test, and both before and after, the engine testers compile a log sheet to give a complete history of each engine. More than 2000 items are entered on every sheet. These readings show manifold pressure, r.p.m., percentage of rated speed, carburetor mixture, observed and corrected horse power, fuel consumption and oil consumption in pounds per horsepower hour, and all operating pressures and temperatures.

(*Continued on page 151*)


ETHYL ALCOHOL for lacquers, pharmaceuticals, smokeless powder
ETHYLENE DICHLORIDE for vitamins, anti-knock fluid, plastics, insecticides

Molecular Keys To A New World

VAST NEW SOURCES of raw materials . . . the equivalent of those which might be found in a great new continent . . . opened to America when CARBIDE AND CARBON CHEMICALS CORPORATION, a Unit of UCC, started building synthetic chemicals from water, salt, air, and hydrocarbons.

These chemicals are usually water-white liquids, although some are gases or solids. Basically, they are compounds of carbon and hydrogen—united with oxygen or with chlorine to build up an endless series of chemicals. The models of those molecules of chemicals shown here are many millions of times actual size.

These chemicals are the raw materials for fabulous plastics . . . amazing textile fibers . . . life-saving drugs . . . vitamins by the carload . . . synthetic rubber . . . more things and better things than were possible before their existence.

Since these chemical wonders are obtained from abundant domestic sources, their use has contributed materially to the nation's self-sufficiency. Through research, American ingenuity, and patient development, scarce natural products have been duplicated or improved upon. Great new industries and great new materials that contribute to the nation's strength have come into being. And America has become a leader in a field as native as its own soil.

Broadly speaking, the uses of many of the synthetic organic chemicals developed by CARBIDE AND CARBON CHEMICALS CORPORATION are just beginning. The already established uses are indicative of their vast future values to mankind.

BUY UNITED STATES WAR BONDS AND STAMPS

BETTER MEDICINES! Amazing medicines like the sulfa drugs, synthetic vitamins, powerful insect repellents, and anti-malarial drugs depend upon synthetic organic chemistry.

COLD PROOF! Coolant for liquid-cooled aircraft engines and base for anti-freeze in military cars and trucks is ethylene glycol, an important synthetic chemical.

MAGIC PLASTICS! Wonderful plastics that look like glass, stretch like rubber, and which are proof against water, sunlight, oils, and many chemicals are made from VINYLITE synthetic resins.

MAN-MADE! All types of synthetic rubber require synthetic organic chemicals for their manufacture. Here's hope for tires for you in the future.

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Announcing

T.C.C. BEAD *Synthetic* CATALYST

- improves performance of Houdry and T. C. C. Units* beyond any catalytic operation known to date
- actual cost in commercial operation is lower than that of any other catalyst
- exceptional catalyst activity with very little loss in service
- far greater strength and resistance to wear than other catalysts

*All twenty-two T.C.C. Units under construction were designed and are being built by Lummus. Licensed by Houdry Process Corporation.

INCREASE IN AVIATION GASOLINE YIELDS WITH T.C.C. BEAD CATALYST

	Clay or Best Present Day Catalyst	T.C.C. Synthetic Beads	% Relative Increase in Yield from Beads
Stock A — Mixed Base Type	100	113	13%
Stock B — Naphthenic Type	100	125	25%
Stock C — Paraffinic Type	100	130	30%

INCREASED POWER OUTPUT, SUPERCHARGED ENGINES

	Best Present Process	T.C.C. Synthetic Beads	% Increase
Fuel A — Mixed Base Type	100 H.P.	126 H.P.	26
Fuel B — Naphthenic Type	100 H.P.	135 H.P.	35
Fuel C — Paraffinic Type	100 H.P.	123 H.P.	23

Resulting in

13% to 30% increased production of an improved quality product from a given plant. 23% to 35% increase in power output.

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LUMMUS

PETROLEUM REFINING PLANTS

FINAL EXAM

(*Continued from page 148*)

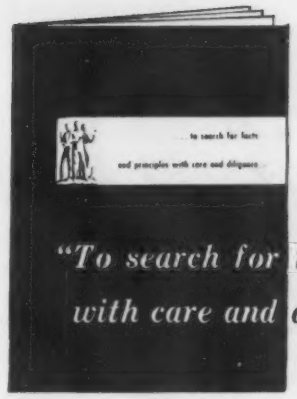
In all tests, however, weather conditions, fuel mixture strengths, and slight variations in engine timing characteristics will cause engines to vary from their normal power and speed ratings, and limited tolerances have been set up to compensate for these variables.

The manufacturer is mainly concerned with power performance control on stands designed for use with test clubs, rather than with dynamometer controls. However, when an engine of any given model is first released for production, the model undergoes testing on the dynamometer to determine its performance characteristics.

If the engine proves normal in every respect, then a chart is made of a family of curves of manifold pressure versus speed, versus horse power, and versus fuel consumption. These are corrected as required to standard conditions of atmospheric pressure and temperature by the standard formula that for any degree of throttle opening, the power will vary, with changing atmospheric conditions, directly as the dry air pressure and inversely as the square root of the absolute temperature.

With a family of wooden test clubs of different sizes, for varying weather conditions, together with a series of manifold pressure curves constructed from dynamometer data, it is possible to determine the true power of an engine operating under any and all atmospheric conditions.

A view of an instrument panel in one of the test cells, with an engine tester at the throttle and carburetor mixture controls. Double-glass window gives the operator a clear view into the cell, a distinct help in starting and cutting off engine, in checking on carburetor mixture by color of exhaust flames, in detecting any possible oil leaks or loose connections. *Wright Aeronautical Corporation*



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3306 . . . is the title of our Bulletin OK-1005A, which tells the story of wire and cable research.

Every engineering student will be very much interested in this Bulletin which tells about methods and procedure in a manufacturer's research laboratory.

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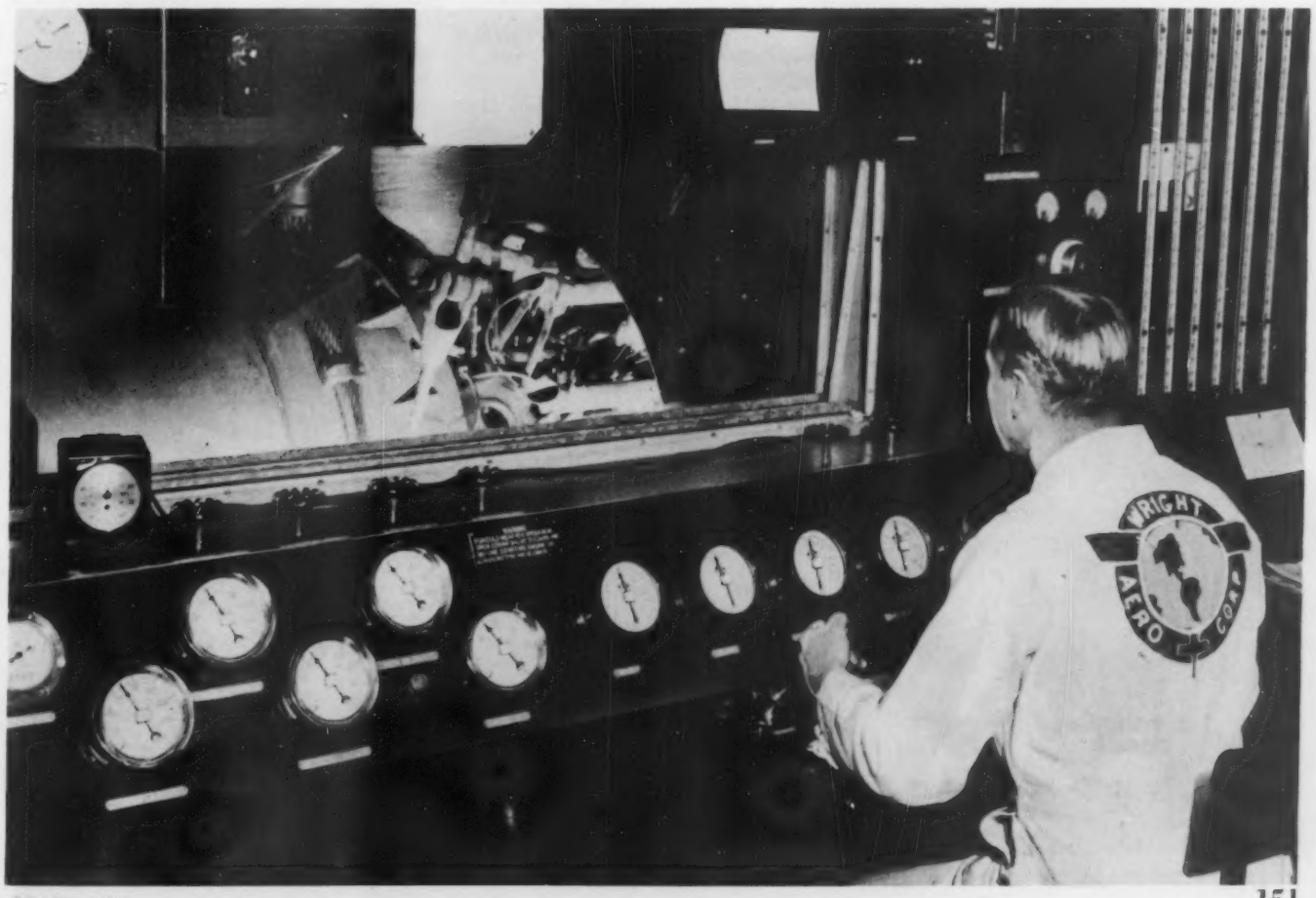
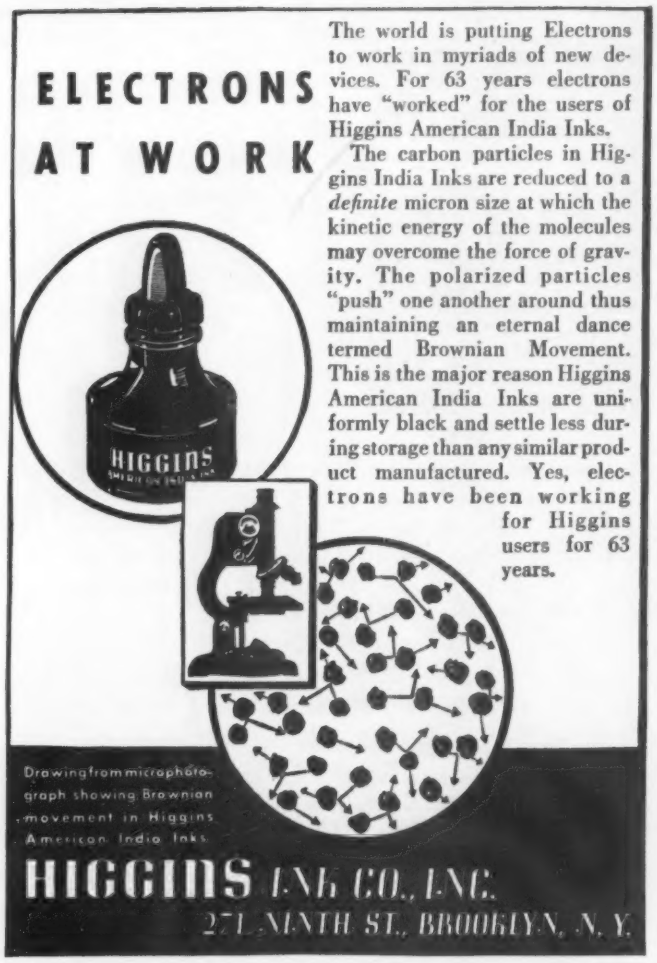



ELECTRONS
AT WORK
The world is putting Electrons to work in myriads of new devices. For 63 years electrons have "worked" for the users of Higgins American India Inks.
The carbon particles in Higgins India Inks are reduced to a *definite* micron size at which the kinetic energy of the molecules may overcome the force of gravity. The polarized particles "push" one another around thus maintaining an eternal dance termed Brownian Movement. This is the major reason Higgins American India Inks are uniformly black and settle less during storage than any similar product manufactured. Yes, electrons have been working for Higgins users for 63 years.
HIGGINS
Drawing from microphotograph showing Brownian movement in Higgins American India Inks
HIGGINS INK CO., INC.
271 NINTH ST., BROOKLYN, N. Y.

BETTER SAND FOR BETTER CASTINGS

(*Continued from page 135*)

in terms of a number indicating the screen number which would just pass the average sand grain in the sample. Most foundrymen prefer, however, to note the size distribution of grains by recording the weight of sand remaining on each sieve. For the fine sands, a smooth surface would be expected on the casting, but the permeability of the mold would be low.

The permeability of molding sand is the property of openness or porosity which allows the gases formed within the mold cavity to escape without causing gas pocket defects on the casting surface. In the standard permeability test, the rate of flow of air under a given pressure through a rammed sample is measured. Many factors affect this property, and the most important are fineness, density developed by ramming, type and amount of binder, and moisture content. Sands of high permeability have good venting qualities.

The most common strength test made on sands is the compression test on a cylindrical specimen two by two inches. The results are expressed in pounds per square inch, and this property proves very useful in determining the ability of the sand to resist crushing, to resist washing by the metal during pouring, and to retain the details of the mold cavity during pouring without crumbling.

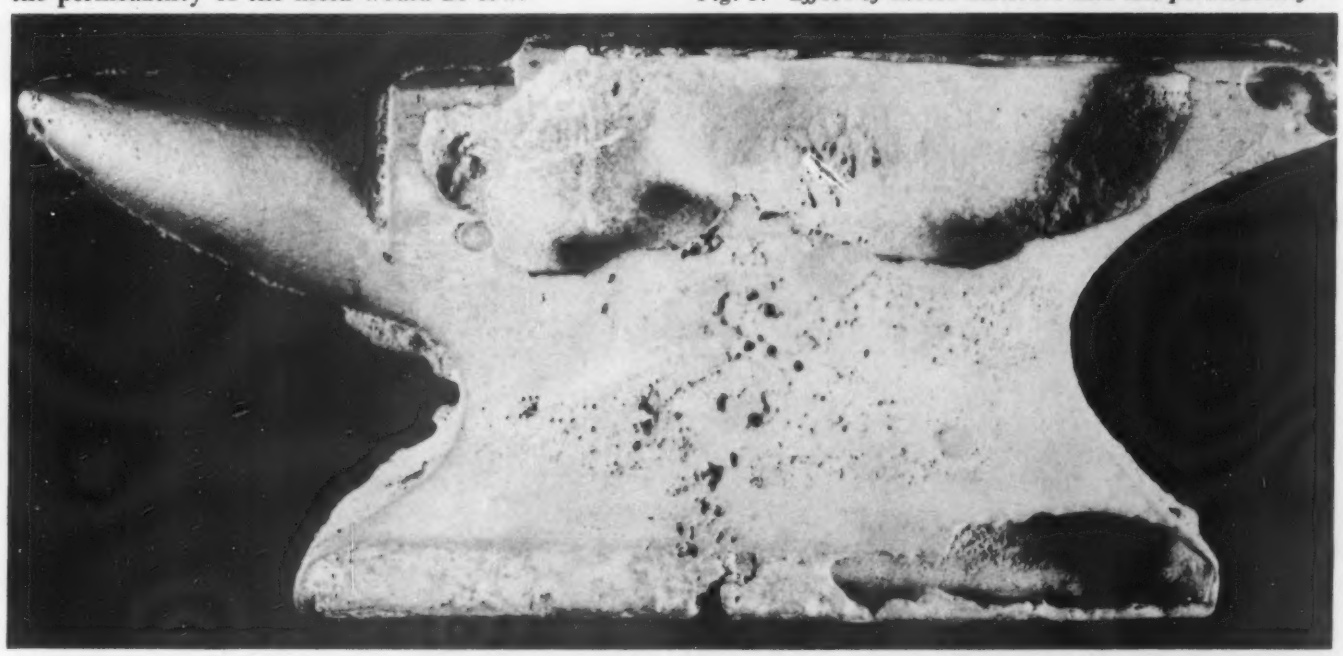
There are other tests which can be performed on sands, but to date these have not been developed to the stage where they could be accepted as standard. Among these is the flowability of sand during mold preparation, the deformation of mold surfaces under the load of the molten metal, and particularly the properties of sands at the temperatures to which they are subjected in the casting process. Much attention is now being given to the problem of high-temperature properties by the steel foundry interests where the conditions in this respect are most severe.

In addition to these tests on sands, there are similar properties which can be measured by tests on the baked sand cores which are normally used to produce cavities within castings. These tests have not been standardized, however, but a transverse strength test is often used to judge the load carrying capacity or the relative resistance to crushing of cores. These test procedures are now becoming more important, since molding practice involves the wider use of molds made up completely of baked cores. The permeability of core mixtures is equally important, since the binders used in core making are quite likely to increase the total gas content within the mold during pouring.

Considerable time has been devoted to the classification of casting defects and their causes, and the liter-

(*Continued on page 154*)

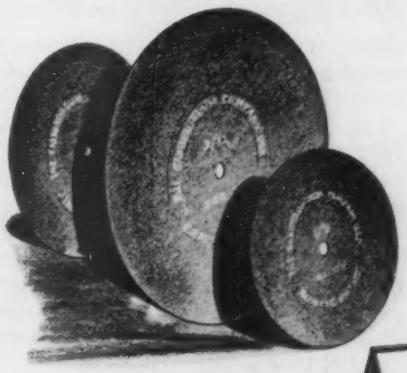
Fig. 1. Effect of excess moisture and low permeability



Set 'em up in the other alley!

Ever wonder where our anti-tank weapons get their wallop? Part of the answer is in the way the armor-piercing projectile is made. Hardened at the point, it is made softer toward the base to prevent shattering on impact. Proper range of hardness is insured by testing a section sliced length-wise from the center of a sample projectile. But how do you cut steel tough enough to pierce a tank? With a cutting off wheel such as made by Carborundum!

Cutting off wheels are abrasive discs that are amazingly tough and often extremely thin. They do the work in a fraction of the time required by ordinary methods. Their high precision adapts them to the most delicate operations such as slotting pen points. Such wheels are now used to cut plastics, glass, brick, tile, steel and non-ferrous metals in plate and bar stock. Frequently further finishing is unnecessary.



When you take your place in the war industries, keep Carborundum in mind. We will always be ready to help you with problems where the use of abrasive products is involved. The Carborundum Company, Niagara Falls, New York.

CARBORUNDUM
Reg. U.S. Pat. Off.
ABRASIVE PRODUCTS

Carborundum is a registered trade-mark of and indicates manufacture by The Carborundum Company.

Fig. 3. Core blow resulting from low core permeability and excessive core gases

BETTER SAND FOR BETTER CASTINGS

(*Continued from page 152*)

ature contains most of this information. A typical defective casting is shown in Figure 1. Due to the cleanliness of the cavities in this casting, it is apparent that excess gas was present, and during pouring, the metal was prevented from completely filling the mold. A check on the mold condition indicated that there was an excess of moisture used in mixing the sand. This would account for considerable steam. A fineness test indicated that the size of sand grain was only suitable for much smaller castings of lower melting point metals. The permeability resulting from the above conditions was, therefore, exceedingly low. The remedy for this type of defect was obviously the choice of a coarser sand and better control of moisture.

The cavity shown at the base of the sprue in the small casting shown in Figure 2 was filled with sand when first removed from the mold. By careful examination it can be seen that some of the sand at the point where the sprue hole joins the mold cavity was removed either during handling or pouring of the mold. This is evidenced by the rough fillet effect at this point. This loose sand floated on the metal as pouring progressed and unfortunately did not escape up the sprue hole. Although rough handling could have caused this defect, it is quite likely that the strength of the sand was low. This could be due to low moisture or insufficient clay or both.

Figure 3 shows a section through a cored cylindrical casting. Here again the clean cavity gave evidence of excess gas in the mold. In this case, however, it appears quite likely that the excess gas came from the baked sand core. The top part of the casting had evidently solidified in a very thin layer before the gas was evolved from the heated core. For this reason the gas was trapped within the metal, and the sand permeability never became a factor. Had the core been permeable, this escape could have been through the core ends. This gas under pressure, therefore, displaced a certain amount of the metal out through the gating system and gave rise to the cavity shown here. The remedy is,

Fig. 2. Results of sand drop due to low strength

therefore, to increase the permeability of the core by use of a coarser sand and to minimize the gas formation from the core by reducing the ratio of binder to sand.

A defect such as the small cracks shown on the surface of the cored casting in Figure 4 is much more difficult to detect. Except by careful inspection, such a part might easily find its way into a completed machine, and there cause failure. Although not quite evident in this photograph, the shape of the casting is similar to that shown in Figure 3, including the cylindrical core. A study of the core properties showed a particularly high strength which was not actually necessary for the job. On the basis of this finding, it appears quite certain that as the casting cooled from the solidification temperature the internal core did not crush sufficiently

Fig. 5. Cold shuts and misruns due to low sand permeability and low metal fluidity

to prevent a stress build-up in the casting wall. This stress oftentimes can be of sufficient magnitude to crack castings at room temperature, but usually, as is the case here, the cracks develop while the casting was still hot.

Cold shuts and misruns are common types of defects. In Figure 5, three bronze slotted eye bolt castings are shown with the castings (5a and 5b) having one side cut away to show the inside surface of the slot. The slots were made by means of a flat slab core, and the metal entered the mold at the opposite end of the bolt about six inches away. Figure 5c appears to be definitely a misrun due to the metal being sluggish after running the entire length of the mold cavity. This misrun was also undoubtedly partly caused by low permeability of the molding sand which allowed gas pressure to oppose the running of the metal. The small tongues of metal on the inner surface of the slot, shown in 5a and 5b, were due to the same causes as the defect in 5c, with the exception that possibly the chilling effect of the cold core is more pronounced. The remedy for this situation was to provide a more permeable sand, gate the casting nearer to the cored end, and try to improve the fluidity of the metal by increasing the pouring temperature or making a change in the alloy used. From the foundry point of view, this eliminated the trouble, but from the design point of view, this slot should perhaps be completely milled rather than cored and finish faced.

There are many other defects which can be attributed to sand conditions and which lend themselves to the same type of analysis used in the above examples. With proper test equipment and a suitable control program, any foundry can decrease their scrap losses, due to defective castings, tremendously. The job of organizing such a control program in a foundry has, in most cases, been given to the plant metallurgist or plant engineer. For this reason an introduction to this field of control should prove to be a valuable part of the training of engineers in these fields.

Fig. 4. Cracks in cored casting due to high core strength

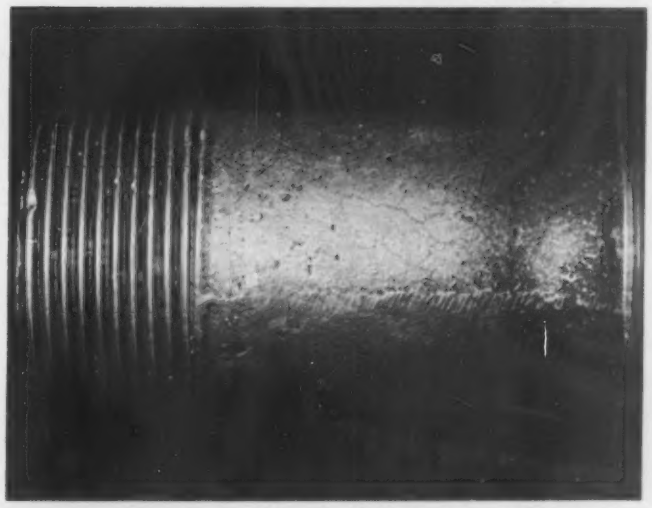


TABLE I
GENERAL PROPERTIES OF MOLDING SAND

	Brass Sands (Small)	*Brass Sands (Large)*	*Iron Sands (Small)*	*Iron Sands (Large)*	*Steel Sands*
Per Cent Silica	75–80	75–80	75–85	75–85	80–98
Grain Fineness	200–225	100–150	100–150	25–50	25–100
Per Cent Clay	6–15	7–10	10–20	10–15	1.5–4
Permeability	8–12	17–25	20–50	125 up	100 up
Green Comp. (lbs.)	3–4.5	3.5–6	3–8	6–10	4–8

Data taken from "Foundry Sands" by A. A. Grubb, Ohio Brass Company.

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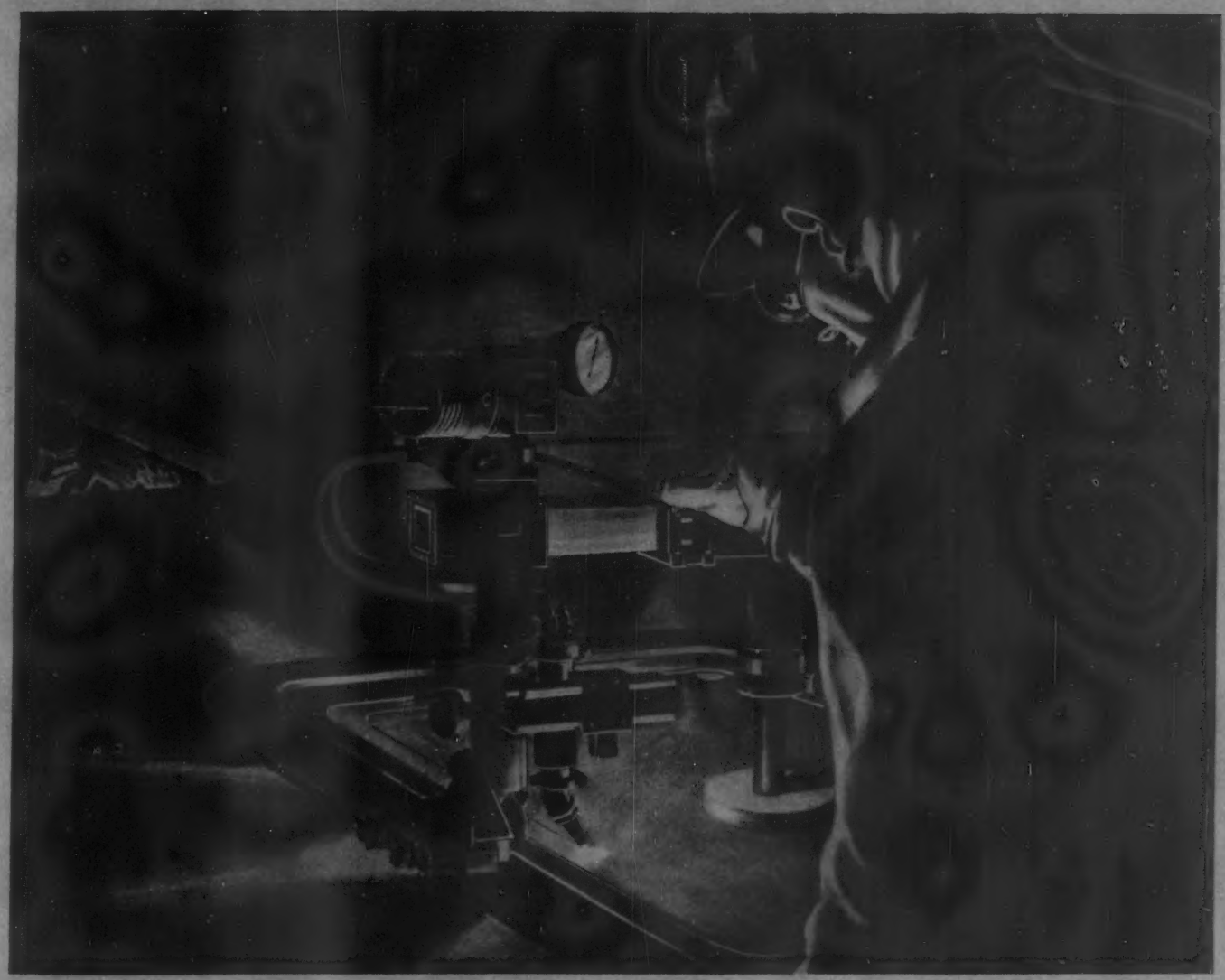

SLICING DAYS OFF SHIPBUILDING SCHEDULES . . .

UNTIL recently, cutting hatchway openings out of heavy deck plating was a bottleneck in the construction of certain types of ships. It was a slow, costly job requiring many laborious machining operations.

Could the oxyacetylene flame eliminate this bottleneck? This was the problem presented to Airco's research engineers by one of its customers. The problem was solved by an entirely new gas cutting machine, designed and constructed specifically to handle this job.

With this machine it is possible to cut beveled openings, rounded at the corners, out of thick steel plate—all in a single continuous operation! The finished cut is smooth and clean, and more important, the openings are cut in 1/120th the time required by the former method. Today this machine—the Airco Polygraph—has become standard equipment in shipyards and many other war production plants throughout the country.

This development is typical of the achievements resulting from the teamwork of Airco engineers and its customers—each contributing their specialized knowledge towards one common objective.

If you want to keep posted on some of the most recent developments and applications of oxyacetylene flame and electric arc processes, write for a free copy of the illustrated booklet, "Airco in the News." Please address your requests to Air Reduction, Room 1656, 60 East 42nd Street, New York.

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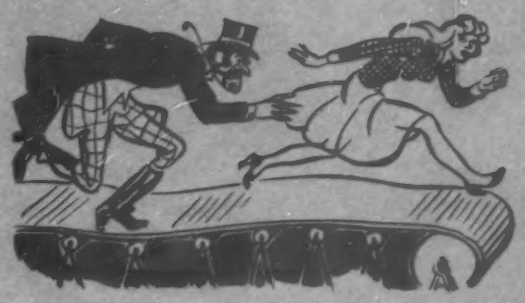
G-E Campus News

RESEARCH AND ENGINEERING KEEP GENERAL ELECTRIC YEARS AHEAD

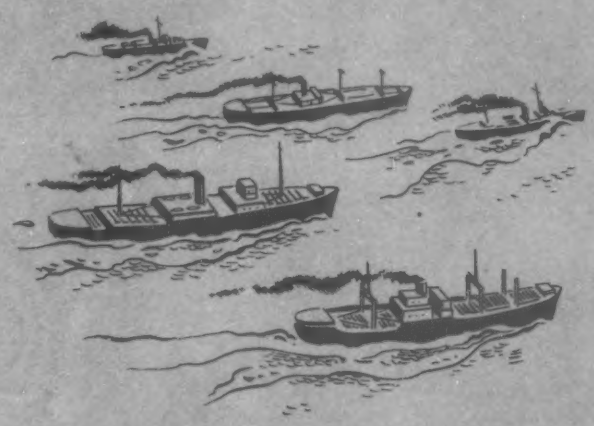


FOILED!

WHEN in a movie "the villain pursues and pursues her," he's not really getting anywhere at all.

To keep the players within camera range while they are constantly on the move—going nowhere—the Metro-Goldwyn-Mayer studios are now using a sound-insulated treadmill, powered by General Electric.

An even motion was required through all the action shots, from a slow walk to a race. Now, in 30 seconds, the treadmill can be accelerated smoothly from zero to full speed in either direction, by means of a G-E motor-generator set.



LEND-LEASE IN REVERSE

USUALLY we think of the United States as the arsenal and machine shop of democracy, but actually the Atlantic is a two-way ocean. And General Electric recently announced that since early in 1942 the Company has been using five giant English metal-working machines in the production of vital ship-propulsion equipment.

The machines were sent from England in separate ships on different dates, to forestall their destruction by German submarines. One of the ships was attacked during the crossing and was damaged but made its American port safely.

The arrival of the machines was really *two* strikes against the Nazis, for had they remained over there they might not now be producing for the United Nations. One of them had been installed in a plant in Sheffield, and another was destined to go there—and that city was later bombed by the Axis.

"PAPER DOLLS"

RIGHT out of the kindergarten is the latest metal-saving technique in General Electric. Many thousands of complexly designed parts are required for intricate electric apparatus—and all must be cut from flat sections of scarce metals.

So, just like patterns for paper dolls, the planners draw the parts to scale on paper, cut them out, and shift them around till they mesh together in a manner very similar to a jigsaw puzzle.

Frequently it is possible to redesign the parts when it is found that slight changes in the length, width, or thickness will allow more parts to be cut from the same layout.

Photographs of this technique may be obtained free by writing Campus News, General Electric Company, Schenectady, N. Y.

Listen to the "Hour of Charm" at 10:00 p. m. EWT, Sundays, on the NBC network, and the G-E news program with Frazier Hunt at 6:00 p. m. EWT, Tuesdays, Thursdays, and Saturdays on the CBS and American (FM) networks.

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